Preservation of memory for generalities in amnesia

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A thesis submitted for the degree of Doctor of Philosophy
in the Psychology Division, The Australian National University

July 1998

This thesis describes original research carried out by the author in the Division of Psychology of the Australian National University. Aside from the usual advice given by supervisors in the course of such study, the work reported in this thesis was performed solely by the author. This thesis has not been submitted for a higher degree at any other university or institution.

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N.B. The above statement notwithstanding, some of the material contained in this thesis is reported in the following articles:

Haslam, C., Coltheart, M., & Cook, M. (1997). Preserved category learning in amnesia. Neurocase, 3, 337-347.

Haslam, C., Cook, M., & McKone, E. (in press). Memory for generalities: Access to higher-level categorical relationships in amnesia. Cognitive Neuropsychology.

Acknowledgments

My reason for undertaking doctoral research was primarily to gain an education and I am indebted to a number of people who have supported me in this endeavour. I owe most to Dr Michael Cook who played an essential role in my intellectual development both as sparring partner and as counsellor. I am only sorry for future students who will not have the benefit of his vigorous approach to supervision as he nears retirement. I also wish to thank Professor Max Coltheart for his contribution to the empirical program and helpful comments throughout this research. Other academic advisors, including Dr Elinor McKone and Professor Marie Carroll, also provided valuable support at various stages in this research.

In conducting research there are always technical and practical problems to overcome. In this regard I would like to thank the technical staff in the Psychology Division at the ANU, in particular Shane Pozzi, for helping in development of materials used in some experiments, and the Department of Psychology at the Canberra Hospital for access to their test library.

I am extremely grateful to the patients and families who took part in this research and to a number of colleagues — Philippa Hedges, Gail Robinson, Amanda Stevenson and Ursula Johns — for their assistance in referring prospective participants. There are also several other people that I would like to thank for providing me with emotional support during some of the most trying times. I could not imagine having completed this thesis without the patience, endurance and intellectual support of my husband Alex Haslam. Kate Reynolds and Felicity Benn were particularly helpful in both showing the way and providing me with a sounding board whenever required. Finally, I would like to thank my family for their support in my choice of career and for being there despite their own trials.

Contents

List of Figures

List of Tables

Abstract

The pattern of preserved and impaired abilities observed in amnesic patients has been used to draw conclusions about the structure and function of normal memory. Yet our understanding of the memory disturbance in this condition is limited. This thesis presents a novel perspective on the preserved and impaired capacities of amnesic patients based on a differentiation between item-specific and higher-level categorical knowledge. The dissociation of categorical knowledge from exemplar knowledge — referred to here as *preservation of memory for generalities* — has previously been demonstrated in particular forms of dementia. However, there are some indications that it might also occur in amnesia (e.g., Haslam, Coltheart & Cook, 1997). The aim of this thesis is to provide an exploration of the memory for generalities phenomenon in amnesia.

The phenomenon of preserved memory for generalities was investigated in three amnesic patients. Two of these patients suffered from anterograde amnesia and one suffered from both anterograde and retrograde amnesia. In all studies, knowledge about people was investigated (i.e., face-occupation or face-name-occupation associations). The first five experiments provide evidence of preserved memory for generalities in anterograde amnesia. In Experiment 1 preservation of memory for generalities was shown for novel face-occupation associations. Patients remembered higher-level semantic attributes of occupations (e.g., educator, tradesperson) but not the more specific studied associations (e.g., teacher, lecturer, electrician, plumber). The influence of study context was investigated in the second study and it was found that one patient could discriminate between people at a level of categorization that had not been accessible in the earlier experiment (i.e., teacher/lecturer). These experiments examined memory *indirectly*. Here, higher-level knowledge was revealed in the pattern of response confusions that were made when patients were asked to

discriminate between people on the basis of their studied occupations. However, patients could not access the same information when higher-level knowledge was examined *directly* (Experiment 3). Although this finding suggests that the generalities phenomenon might simply be a product of testing procedure, results of Experiments 4 and 5 showed that higher-level knowledge could be accessed directly provided the information was sufficiently general. It was concluded that the phenomenon was not based on the mode of response employed at test, although it was also clear that indirect methods of testing facilitated memory performance in the amnesic patients.

Evidence of preserved *remote* memory for generalities was also found in the one patient with retrograde amnesia. This patient retained sufficient knowledge to support higher-level, but not lower-level, distinctions on direct tests in autobiographical (Experiment 6) and public (Experiment 8) domains. In both knowledge domains a difference was found in the amount of information that could be accessed in the two modalities (i.e., faces and names). Furthermore, in the autobiographical domain, it was shown that indirect tests facilitated access to knowledge that was not available on direct tests (Experiment 7). A final experiment investigated the preservation of memory for generalities phenomenon in a non-impaired sample. While these participants also displayed superior memory for generalities under conditions of partial learning, no difference was found in their performance on direct and indirect tests. The latter result provides additional support for the notion that the preservation of memory for generalities phenomenon is not simply a consequence of testing procedure.

The preservation of memory for generalities phenomenon cannot be accommodated by current theories of amnesia. Furthermore, of the two main approaches proposed to explain the phenomenon in dementia, only one theory (referred to as a "fragmentary knowledge" account) explains the majority of our findings. The implications of modality-based differences in access to person-related knowledge for models of face recognition are also considered. Overall, the present series of experiments show that preservation of memory for generalities is not restricted to dementia or amnesia. Its occurrence in a non-clinical sample suggests that it can occur under *any* conditions of poor memory and thus should inform our understanding of memory processes and organisation in general.

Chapter 1

Memory for generalities in amnesia: An introduction

Our understanding of normal memory function has been advanced considerably in the course of studying the pattern of preserved and impaired abilities in patients with organic memory dysfunction. Not only do these patterns help to clarify the nature of the particular memory disorder in question but, at a more fundamental level, they play an important role in the development and revision of theories of memory structure. The purest form of memory disturbance occurs in the amnesic syndrome, which results from a variety of neurological conditions including cerebrovascular accidents, anoxia, Wernicke-Korsakoff syndrome and herpes simplex encephalitis (see O'Connor, Verfaellie & Cermak, 1995, for a discussion). Although there is some disagreement about how exactly to define amnesia (e.g., see Knight & Longmore, 1991; Mayes & Downes, 1997; O'Connor et al., 1995), most researchers agree that this condition is characterised behaviourally by a profound disturbance to memory, which can affect both remote and newly acquired knowledge, and a general preservation of remaining cognitive functions.

There have been various attempts to explain the memory loss in amnesia and some of this work has focused on memory dissociations. Various dissociations have been proposed in an effort to identify what these patients can and cannot remember. Essentially, this process of characterizing the memory disturbance in amnesia entails contrasting two alternative classes of material — one which is processed normally by patients and the other which is processed abnormally. While it has been argued that dissociating a complex function such as memory into two systems or processes is simplistic (e.g., Baddeley, 1982a), it must also be noted that the study of memory dissociations has advanced our understanding of the amnesic condition. Perhaps the most prominent dissociation is that between short-term memory (STM) and long-term memory (LTM). Amnesic patients provide one of the primary sources of evidence for this particular memory dissociation given that, on superficial analysis, their memory disturbance seems to be characterized by preservation of STM (together with premorbid LTM) and an inability to store new information in LTM. Preservation of STM has been demonstrated most convincingly on tests of immediate memory span (e.g., Baddeley & Warrington, 1970; Butters & Cermak, 1980), and this particular capacity represents one of the core features of amnesia that is not bound by specific pathological presentations of the condition.

With increasing evidence of preserved priming (e.g., Graf, Squire & Mandler, 1984; Jacoby & Witherspoon, 1982; Moscovitch, 1982; Warrington & Weiskrantz, 1970, 1974) and skill-learning (e.g., Brooks & Baddeley, 1976; Cermak, Lewis, Butters & Goodglass, 1973; Corkin, 1968) in amnesia, it became apparent that at least some information was also retained in long term memory. A number of other memory dissociations were proposed to account for the selective preservation of information in long-term memory. One account explains the pattern of preserved and impaired abilities in amnesic patients in terms of a dissociation between semantic and episodic memory. According to this proposal, semantic memory, which comprises our factual and general knowledge about the world, is preserved in amnesia while knowledge of the particular circumstances in which information is acquired — or episodic memory — is selectively impaired (Kinsbourne & Wood, 1975; Parkin, 1982; Tulving, 1983). However, disillusionment with this suggestion, largely arising from limited support for new semantic learning in these patients, led to alternative proposals of memory dissociations in amnesia. Cohen and Squire (1980) argued that both semantic and episodic memory were impaired in amnesia. They suggested that both types of memory required conscious recollection of facts and episodes — a function they attributed to the declarative memory system.

Preservation of function was supported by procedural memory, a system believed to be responsible for the expression of memory through behaviour or performance (e.g., skill learning, conditioning and priming). Again though, there is disagreement about whether this distinction adequately characterises the pattern of memory impairment and preservation in amnesia. Not only has the concept of procedural memory been criticised because it is too general, but even despite its generality, it fails to encompass all aspects of preserved ability in amnesia (e.g., preservation of short-term memory and various forms of priming, Baddeley, 1990; Eysenck & Keane, 1990).

Both the semantic/episodic and procedural/declarative accounts attribute the pattern of preserved and impaired ability to different underlying memory systems. There are other explanations that attribute the memory disturbance to a deficiency in processing particular information. The implicit-explicit dissociation is one example of this. As in the case of procedural/declarative memory, consciousness play a key role in this dissociation — memory is expressed implicitly when performance is enhanced without conscious awareness and memory is expressed explicitly when conscious recollection is invoked (Graf & Schacter, 1985; Schacter, 1985). For the purpose of explaining the amnesic syndrome, it has been suggested that implicit memory is preserved and explicit memory is impaired in these patients (Graf & Schacter, 1985; Schacter, 1985). However, as an explanation of amnesia, the implicit/explicit account also has limitations. Like other memory dissociations it is descriptive and hence, on its own, it cannot explain the nature of the deficit(s) in amnesia (Schacter, 1987). There are also aspects of amnesic memory performance that cannot be explained by the implicit/explicit dissociation. For instance, this theory cannot account for preservation of immediate or short-term memory in these patients. Because performance on these tests requires conscious recall, the proposal that amnesics are impaired on all explicit memory tests is obviously false. Furthermore, there is some debate about the degree of explicit memory impairment in amnesia and in particular, whether it is disproportionately impaired for certain kinds of materials (see Mayes & Downes, 1997, for a discussion).

There is considerable disagreement over how to describe the nature of the deficit in the amnesic syndrome. The various proposed dissociations have been debated in the amnesia literature for some time and as yet no resolution has been reached. Given the lack of agreement about the nature of the memory disturbance, it is probably not surprising that there is also little agreement about the stage of information processing implicated in these dissociations (i.e., encoding, storage/consolidation and retrieval). Clearly, the above dissociations have failed to characterise the pattern of impaired and preserved ability in amnesia adequately and thus there is still much to be learned if we are to advance thinking about this condition and memory function in general.

The purpose of this thesis is to examine a novel feature of the deficit in amnesia involving a differentiation in performance on tests of exemplar and higher-level categorical knowledge. It is shown that the memory disturbance observed in amnesic patients is characterised in part by impairment of item-specific (i.e., exemplar) knowledge and preservation of more general (i.e., higher-level) categorical knowledge. This pattern of disturbance will be described as *preservation of memory for generalities.* Although this phenomenon has previously been reported in patients suffering from particular dementing conditions, there is evidence to suggest that it may occur in amnesia.

The dissociation of higher-level category knowledge from exemplar knowledge was first identified by Warrington (1975). She found that patients with selective impairment of semantic memory could describe items in terms of their broad class or superordinate category, but could not identify them precisely. Since Warrington's paper there have been many reports of this phenomenon in particular forms of dementia (e.g., semantic dementia, Alzheimer's disease) and this has been illustrated in a range of tasks. Preservation of higher-level categorical knowledge has been demonstrated in object naming, definition, sorting, fluency, probe questions (both category and attribute) and word-picture matching (Chertkow, Bub & Caplan, 1992; Funnell, 1995; Hodges, Graham & Patterson, 1995; Hodges, Patterson & Tyler, 1994; Martin, 1987).

The evidence in support of preserved memory for generalities comes mainly from patients suffering particular forms of dementia, and it may be that the phenomenon is restricted to these conditions. A recent study challenges this view. Haslam, Coltheart and Cook (1997) found evidence of preserved categorical knowledge and impaired item-specific knowledge in an amnesic patient, MK. This patient was asked to learn a series of picture-name associations from two well-known categories — animals and fruits/vegetables. When knowledge for these associations was tested it was found that MK could only discriminate items on a categorical basis (i.e., whether they belonged to the animal or fruit/vegetable category). He could not make more detailed discriminations such as those involved in distinguishing two items from the same category. Thus, not only had MK provided evidence of new learning in amnesia, but his results suggested an alternative analysis of the deficit in amnesia. Because the knowledge he acquired could only support discrimination at a superordinate level, it was considered possible that MK had either acquired partial knowledge or could only retrieve partial knowledge that was semantically-related to the studied items.

Some other studies report results which could be interpreted as evidence of partial knowledge in amnesia, even though preservation of memory for generalities was not the primary issue under investigation. Knowlton, Squire and colleagues (Knowlton, Mangels & Squire, 1996; Knowlton, Ramus & Squire, 1992; Knowlton & Squire, 1993, 1994, 1996; Squire & Knowlton, 1995) found that amnesic patients acquired sufficient knowledge of artificial grammar to differentiate grammatical from non-grammatical letter strings. Although patients were successful in performing this categorical task they had no memory for the specific materials used in training. In another study, Verfaellie, Croce and

Milberg (1995) found that an amnesic patient acquired enough knowledge about novel compound words to identify their correct usage in sentences that maintained the general meaning of the target word. However, they were no better than chance in differentiating sentences that violated the specific meaning of target words. Additional evidence of partial knowledge has been found in amnesic patients when exploring their susceptibility to memory illusions. In these studies, knowledge was indicated in the pattern of errors or semantic confusions that patients made when attempting to recall or recognise items encountered at study (Cermak, Butters & Gerrein, 1973; Schacter, Verfaellie & Pradere, 1996).

A common finding in these studies is the demonstration of partial knowledge in amnesia. The tasks used to examine memory in each case allowed patients to demonstrate partial knowledge when detailed knowledge was not available. Not only does this highlight the importance of examining higher-level categorical relationships when searching for evidence of new learning, but more importantly, it indicates that the patients must have formed some memorial representation of materials they encountered at study. Unfortunately, we know little about the structure of these memory representations. While it is possible that amnesic patients acquire a degraded version of the original study materials (as suggested by Schacter et al., 1996), it is also possible that patients have partial access to a reasonably intact memory representation. Clearly, there is more to be learned about the nature of the memory representation that supports performance on tests of higher-level categorical knowledge and hinders performance on tests of item-specific knowledge. It is this pattern of memory disturbance — the preservation of memory for generalities — which is the focus of the present thesis.

1.1 The present program of research

This thesis presents results of an investigation into preservation of memory for generalities in amnesia. Three amnesic patients took part — IP and GS, who suffered from the anterograde form of the disturbance only, and TG who suffered from both anterograde and retrograde amnesia. Case histories for these patients are presented in Chapter 5.

Two general aspects of memory function were addressed. First, the influence of *test type* (i.e., direct and indirect) was examined. Previous research, particularly in the area of priming, suggests that amnesic patients perform best when memory is tested indirectly (e.g., Graf & Schacter, 1985; Graf, et al., 1984; Jacoby & Witherspoon, 1982; Schacter, 1985; Shimamura & Squire, 1984; Warrington & Weiskrantz, 1974, 1978). Perhaps this is also true of memory for generalities — that is, amnesic memory may be best when higher-level knowledge is tapped indirectly. To address this issue higher-level knowledge was tested both directly and indirectly. In Experiments 3, 4, 5, 6 and 8 higher-level knowledge was examined directly. Up to five levels of detail were examined in these studies, ranging from the very general to the very specific. Indirect examination of higher-level knowledge involved analysis of semantic confusions or errors, and the influence of this form of testing was explored in Experiments 1, 2 and 7.

A second aspect of memory for generalities explored in this thesis concerns the relevance of this phenomenon to both *remote* and *newly acquired* knowledge. The relationship between retrograde and anterograde amnesia, if indeed one exists, is by no means clear. To some degree, this reflects our level of understanding of retrograde amnesia which is relatively poor compared to that of anterograde amnesia. One way to improve this situation is to evaluate the different theoretical positions in terms of their capacity to explain both retrograde and anterograde memory. To address this issue, preservation of remote and newly acquired memory for generalities was investigated in one patient who suffered from both forms of the disturbance. Two domains of remote memory were investigated — public knowledge and autobiographical knowledge.

The plan to investigate preserved memory for generalities in retrograde and anterograde amnesia, had implications for our choice of stimulus materials. In particular, it was important to ensure that materials used to examine past and newly acquired knowledge were of equal complexity. For this reason, investigation of the generalities phenomenon focused on knowledge about people. In the case of remote memory knowledge about famous people was examined. In addition, knowledge about family and friends was explored in the one patient who participated in the autobiographical component of this research program. To examine new learning, details about people unknown to patients were studied prior to testing. The type of knowledge examined ranged from general information about a person (e.g., familiarity, fame) to increasingly more specific detail, including occupational status and a person's name.

In a final study memory for generalities was investigated in non-clinical participants to determine the relevance of this phenomenon to our understanding of memory function in general. It is certainly possible that preservation of memory for generalities is a phenomenon peculiar to individuals suffering some form of brain impairment. However, it is also possible that memory for generalities is better under any conditions of degraded memory and this can even occur in people who do not suffer from memory impairment. If the latter is true, then the difference between clinical and non-clinical populations is merely quantitative — we all show better memory for generalities, but the phenomenon is more pronounced in amnesic patients given their condition is characterised by a profound and ever-present memory disturbance.

In summary, this thesis provides a different perspective on the deficiency in amnesia based on a phenomenon that has been previously explored in dementia. This phenomenon, preservation of memory for generalities, was explored in both amnesic patients as well as in participants without memory impairment. The results suggested that the generalities phenomenon occurs outside the narrow confines of the dementing conditions in which it was first observed. Evidence of superior memory for generalities was found in both amnesic patients and non-impaired controls. However, there were important differences between these groups. In patients, memory for generalities was best when knowledge was examined indirectly. However, the non-impaired group performed equally on direct and indirect tests of higher-level knowledge. Furthermore, the non-impaired sample could access specific details despite being subjected to suboptimal learning conditions — though, as noted, their memory for more general-level knowledge was considerably better. In contrast, patients could not provide *any* specific details and thus, the differentiation observed in their performance was driven solely by *preservation* of more general-level knowledge. Thus, while the conclusion reached is the same in both groups, superior performance on tests of generalities in the amnesic patients may be supported by different mechanisms.

The following chapters present a review of the relevant literature on amnesia and the generalities phenomenon. Evidence in support of the generalities phenomenon is discussed in three parts. First, the dissociation between exemplar and categorical knowledge with respect to dementia is discussed and this is followed by a discussion of the evidence from patients suffering amnesia. Finally, a preliminary study (Haslam et al., 1997) which explored the generalities phenomenon directly in amnesic patients is discussed in greater depth as this served as the catalyst for the current program of research. After a number of empirical chapters which explore memory for generalities in the manner outlined above, we then return to consider the broader implications and utility of this phenomenon for the study of memory as a whole.

Chapter 2

The amnesic syndrome: Description and theory

2.1 Describing amnesia

Amnesia is characterized by a pattern of preserved and impaired ability. The primary characteristic is a profound disturbance to memory which presents in the context of preserved intellectual function. Amnesia can affect memories which existed prior to the onset of the condition or it can affect newly acquired memories. These forms of the amnesic memory disturbance are referred to as retrograde amnesia (RA) and anterograde amnesia (AA) respectively. It is possible for RA and AA to be present in isolation or together. Mild AA may occur in the context of severe RA or vice versa, and in these cases the condition is usually characterized by the type of memory impairment that predominates. In the case of RA, there are differences between patients in the duration of memory disturbance. Some patients have a relatively short RA, covering a period of several months or years, and others show a more extensive memory loss, involving decades. This is not the case in AA where the deficit to new learning affects all information encountered after the onset of the condition. Irrespective of the form that amnesia takes, it is clear that the memory loss is not complete. Neither remote or newly acquired knowledge is totally impaired. However, as will be outlined below, the pattern of residual abilities observed in these two forms of amnesia differs.

2.1.1 Retrograde Amnesia

Several residual remote memory abilities are commonly reported in patients with RA. One capacity common to all patients is preservation of language. All patients retain their use of an extensive vocabulary as is obvious from their ability to engage in normal conversation. The remaining residual abilities, which include the presence of temporal gradients in memory recall and the sparing of domain-specific knowledge (e.g., preservation of autobiographical knowledge relative to public knowledge), tend to vary among individual patients.

In some patients the memory loss may be temporally graded, with recent remote memories more vulnerable than distant remote memories. This is most common in patients who develop amnesia secondary to the alcoholic Korsakoff syndrome (e.g., Albert, Butters & Levin, 1979; Butters & Cermak, 1986; Kopelman, 1989; Squire, Haist & Shimamura, 1989). There are also patients in whom there is no evidence of such a gradient and this has been reported in cases of herpes simplex encephalitis (e.g., Cermak & O'Connor, 1983; Warrington & McCarthy, 1988) and head injury (Kapur, Ellison, Smith, McLellan & Burrows, 1992).

The memory loss may affect certain types of information more than others. In particular, there are reports of differential performance on tests of autobiographical and public knowledge (i.e., knowledge about famous people and events). Evidence of greater impairment on tests of autobiographical than on tests of public knowledge has been found in one patient (e.g., Markowitsch, Calabrese, Liess, Haupts, Durwen & Gehlen, 1993), while the reverse pattern has been found in other patients (e.g., De Renzi, Liotti & Nichelli, 1987; Kapur, Heath, Meudell & Kennedy, 1986). To complicate matters, there are also patients in whom the deficiency in autobiographical and public knowledge is equally severe (e.g., Cermak & O'Connor, 1983; Warrington & McCarthy, 1988).

These residual capacities are problematic when considered in the context of a clinical description. There is no basis at this stage for predicting whether a person with remote memory disturbance will present with either a temporal gradient or with domain-specific deficits. However, there are various pathologies which may result in RA and this might explain the variation in its presentation. For instance, the pattern of remote residual memory features present in patients with the alcoholic Korsakoff syndrome may differ from those present in patients with herpes simplex encephalitis. The implication of this is that RA should not be considered as a unitary condition, but rather as one with a number of different forms.

2.1.2 Anterograde Amnesia

The pattern of residual learning abilities observed in patients with AA tends to be more consistent than the pattern of residual abilities observed in patients with RA. There are core characteristics which are common to most patients, but characteristics of RA (at least in terms of residual abilities) tend to be more idiosyncratic. There are three areas in which patients with AA have demonstrated their capacity for new learning. They comprise retention of information in immediate or short-term memory, novel skill acquisition and demonstration of knowledge outside of conscious awareness.

One of the most striking features of AA is an apparent dissociation between short-term and long-term memory. In fact, amnesic patients have provided the primary source of evidence for the existence of these memory systems. Patients suffering from AA appear capable of processing novel information normally in short-term memory. This is evident in everyday behaviour and is seen, for example, in their capacity to engage in normal conversation. Preservation of short-term memory has also been reported in laboratory-based tasks involving memory for digits and recency effects in recall of word lists (e.g., Baddeley & Warrington, 1970). However, after interference or a brief delay, when information becomes the province of long-term memory, patients appear to remember no information at all. Although it has been argued that some amnesic patients do not perform normally on traditional tests of short-term memory (e.g., Brown-Peterson paradigm, see Cermak, 1982 for a discussion), there is general consensus about preservation of performance on tests of immediate short-term memory (e.g., digit span).

Another residual ability observed in patients with AA is skill acquisition. Amnesic patients are capable of acquiring skill-based, or procedural, knowledge normally. The tasks that fall in this domain range from practical skills, such as dressmaking and model building (see Ellis and Young, 1996), to laboratory-based tasks which include the ability to track a moving target (Brooks & Baddeley, 1976; Cermak, et al., 1973; Corkin, 1968) and to complete puzzles (e.g., Brooks & Baddeley, 1976). Although patients show improvement on these skill-based tasks, they cannot recall having performed them.

Patients also seem capable of manifesting their newly acquired knowledge implicitly, or outside of conscious awareness, even though they cannot access the same knowledge explicitly (i.e., consciously). Acquisition of skill might be seen as an example of implicit memory, since performance on these tasks does not require conscious recollection of previous study episodes. Priming is another implicit memory phenomenon which appears to be preserved in amnesia. Priming refers to the facilitation in memory performance that occurs as a consequence of practice or previous exposure. Preservation of priming in amnesia has been demonstrated in numerous tasks. For example, in word-stem or fragment completion tasks patients are first shown some words and are subsequently presented with a stem (e.g., mir__ for mirror) or fragment (e.g., _ss_ss_ _ for assassin). They are asked to complete these items with the first word that comes to mind. Priming is evidenced in the tendency to complete these items with words seen earlier (e.g., Graf, et al., 1984; Warrington & Weiskrantz, 1970, 1974). In lexical decision, subjects are asked to identify whether a particular letter string is a word. Priming is indicated by a decrease in the decision time on the second and subsequent presentation of these strings (e.g., Barry, 1988; Smith & Oscar-Berman, 1990). Another commonly used task is perceptual identification. Here, a stimulus is shown briefly and participants are asked to identify it. Evidence of priming is found when the accuracy of identifying previously seen items is better than that for new items (e.g., Cermak, Talbot, Chandler & Wolbarst, 1985). The common feature in all these tasks is that no direct reference is made to previous study episodes. When conscious reference to previous study episodes is required, such as in recall and recognition tests, memory performance declines dramatically.

These residual abilities are often included in descriptions of AA as they are fairly typical of the condition. Accordingly, AA can be summarised as follows:

- a profound and permanent deficit to new learning most prominent under conditions of conscious recollection, which presents in the context of,
- normal intellectual function,
- normal immediate memory span and
- normal skill acquisition.

However, this characterization of preserved and impaired ability in AA is complicated by inconsistency and overlap between the features. Two features, involving conscious recollection and immediate memory, contradict one another. Information in the short-term is recalled explicitly and yet this capacity for conscious recollection is believed to be impaired in amnesic patients. It could also be argued that there is some overlap between other features. For example, skill-based knowledge is usually demonstrated outside of conscious awareness. Accordingly, should skills be included in a knowledge base that supports performance on tests that tap memory indirectly? Together, these complications suggest that descriptions of AA, like RA, may also suffer from a lack of precision.

2.1.3 Summary

Although there is some imprecision in descriptions of RA and AA, the diagnosis in many cases is not in doubt. The residual features may be present in some patients and not in others, and this is particularly problematic in the case of RA. Nonetheless, we are remarkably accurate in diagnosing these forms of amnesia. This is because the diagnosis is based primarily on the severity of the memory disturbance observed. If an individual recalls nothing at all of information presented recently or appears to have a large gap in their past knowledge, then the possibility that they are amnesic must be considered. Thus, the one characteristic feature that can be used to describe *all* patients with amnesia is the severity of their memory disturbance.

It is unclear at this stage whether RA and AA should be considered as separate conditions or different manifestations of the same condition. The fact that AA commonly presents with RA (e.g., in Korsakoff's syndrome and herpes simplex encephalitis) suggests that the two forms of memory disturbance may be caused by the same underlying deficit. However, reports of AA and RA in isolation suggest that they may be different conditions. Without a better understanding of the two forms, particularly the retrograde form, this issue will remain unresolved.

2.2 Theories of amnesia

Evidence of residual memory in amnesia indicates that some knowledge, irrespective of whether it is remote or newly acquired, influences the behaviour of these patients. The question is how do we explain the patterns of memory loss and preservation? Explanations vary according to whether they address the memory deficit to past or newly acquired knowledge. As will become clear, explanations of the memory loss in AA are far more comprehensive than those used to account for RA.

2.2.1 Theories of retrograde amnesia

In contrast to AA, the empirical work that has been conducted with patients suffering from RA is limited, and hence little can be said about this form of amnesia. Despite this, several attempts have been made to explain the pattern of preserved and impaired abilities in these patients. However, these accounts are largely ad hoc, being designed to explain isolated remote memory phenomena observed in particular patients.

Squire (1992) offers an explanation for the presence of temporal gradients in remote memory. He argues that the formation of permanent memory traces takes place gradually and requires the co-ordination of activity between several neurological sites. Initial registration of memory representations takes place in the hippocampal and diencephalic regions. In the process of strengthening these traces, through consolidation and re-organisation, the role of these structures is diminished and is eventually taken over by the association neocortex which is believed to be the place of permanent memory storage. In the end then, retrieval of information from permanent storage can take place independently of diencephalic-hippocampal structures which are believed to be damaged in patients with AA. Thus, Squire suggests that the structures involved in learning differ from those involved in permanent storage and this would explain the temporal gradients observed in patients with RA. Distant memories have received adequate consolidation by the time amnesia develops and they can be retrieved because they are located in a different site to that responsible for new learning. In addition to temporal gradients, this theory can account for isolated RA and the combined presentation of AA and RA — patients who present with the latter have additional damage to the structures involved in the initial registration of memories, which is not the case in the former group of patients. However, there are also patients who present with an extensive remote memory impairment where the information loss in all time periods is equally severe (see Kapur, 1993, for a review of cases). It is implausible to explain such extensive periods of retrograde amnesia as the product of deficient consolidation as it is very unlikely that these processes would take many years to complete.

Hodges and McCarthy (1993) provide an alternative theory of memory loss designed primarily to explain the presence of extensive autobiographical amnesia in a single case. The researchers claimed that this accounted for the patient's inability to recall experiences after his period in the Navy and his constant reference to this particular time frame (it being the last one available to him) in guiding his everyday behaviour. Hodges and McCarthy suggest that the process of retrieval is mediated by a hierarchical memory structure. It is proposed that "thematic retrieval frameworks" (e.g., childhood, marriage, etc.) are contained at the highest level and that these are used to guide the search for autobiographical records which are represented at lower levels of the hierarchy. In such a structure, damage to particular retrieval frameworks would disrupt recall of the specific experiences associated with these, while leaving other frameworks and associated experiences intact.

Another theory of memory storage and retrieval has been proposed by Damasio (1989) and this has been used by several researchers to account for findings in particular cases of RA. Damasio argued that different aspects of events are represented in different regions of the brain and that widespread activation encompassing multiple sites is required for information to be retrieved. One critical component of a memory representation is feature-based information, which is originally registered and stored in the sensory and motor cortices. The other component comprises the spatial and temporal details unique to the event concerned and these are represented in "binding codes". Damasio suggested that binding codes are generated in convergence zones which he proposed were located in the association areas of the brain. He proposed that conscious retrieval of an event requires simultaneous and "time-locked" activation of representations in all these areas.

Damasio's theory suggests that combined activation of the sensory attributes of an event and the temporal context registered at the time of encoding is necessary for the experience to be reconstructed. It has been used to explain the existence of mild AA together with severe impairment to autobiographical memory and visual processing in two patients (O'Connor, Butters, Miliotis, Eslinger & Cermak, 1992; Ogden, 1993). In both cases it was argued that deficits in visual processing (e.g., due to visual agnosia) could reduce retrievability of autobiographical memories as this information is supported to a large extent by visual images. Even though information may be available from other modalities (e.g., auditory modality), an inability to generate or manipulate visual images would reduce the richness of the memory. Damasio's model explains the combined presentation of visual and autobiographical memory impairment. Such patients have an inability to access old visual memories (e.g., involving faces, objects and places). This could be explained by supposing that one of the multiple sensory representations required for recollection, in this case visual attributes, was damaged.

Researchers have also attempted to locate the deficiency in RA at a particular stage of information processing. In some conditions, such as transient global amnesia, the remote memory disturbance can recover (see Kapur, 1993). In these cases it could be argued that the deficiency lies in retrieval mechanisms. Storage deficits have also been proposed to explain RA. If patients consistently fail to retrieve certain information then the deficit is arguably one of storage (Shallice, 1988, Warrington & Shallice, 1979). However, the evidence is inconsistent on this point. Some patients fail to retrieve the same information on repeat testing (e.g., Squire et al., 1989), but others show no consistency in retrieval (Cermak & O'Connor, 1983). This suggests that even if some cases are explicable in terms of storage deficits, this is by no means always the case and the stage of processing responsible for the deficit may vary between patients.

In summary, the pattern of presentation in RA varies between patients and none of these theories accounts for all cases. Each of the theories may be correct in some cases. There is a need to gain a better understanding of the characteristics of the various presentations of RA if we are to develop theories of this condition and determine its relationship with AA. Given the complexity of RA, it seems sensible at this stage to follow Kapur's (1997) advice and examine the various features of remote memory impairment more fully before trying to develop a comprehensive account of all its sequelae.

2.2.2 Theories of anterograde amnesia

We can consider explanations of memory loss in AA from two perspectives. First, the memory loss can be explained in terms of a failure to remember particular types of information. This may result from damage to certain memory systems or from a selective vulnerability in the processing of particular information. In the former case, it could be argued that there are structures in the memory system specialised for different types of information, and that damage to one of these is responsible for the memory disturbance. The alternative position, is that some information is more difficult to retrieve or encode and thus is more sensitive to damage. The former position is based on a *modular/systems* account of amnesia and the latter on a *processing* view of amnesia.

Irrespective of whether the deficit reflects information loss or selective vulnerability, we can also locate the memory disturbance at particular stages in remembering. Accordingly, the memory loss can be considered in terms of deficient encoding, storage/consolidation and retrieval mechanisms.

Modular/systemic accounts of amnesia

Systems theories provide a structural account of memory in which independent systems have been proposed, each containing different information. The deficit in amnesia is explained by damage to one of these systems. There are several ways of conceptualizing these memory structures. One approach has been to attribute preserved abilities to the semantic memory system and impaired abilities to the episodic memory system. Alternatively, the memory disturbance in amnesia can be considered in terms of a dissociation between procedural and declarative memory.

The semantic-episodic distinction

The distinction between semantic and episodic memory was originally introduced by Tulving (1972). Semantic memory was seen as the system responsible for language, and as containing a copious amount of information including knowledge about word meanings, concepts, rules, formulae and symbols. In contrast, episodic memory refers to knowledge of our experiences comprising information about episodes and events in the temporal context in which they occurred. Over time, these definitions have been modified and extended to clarify the role of context (i.e., semantic memory as context free and episodic memory as context-dependent), the knowledge contained within semantic memory (which now includes general knowledge about the world) and the relationship between the two systems (Tulving, 1983, 1984).

Amnesic patients provide the main source of support for the independence of semantic and episodic memory. It is clear that patients with AA retain their premorbidly acquired knowledge of facts and language. Preservation of semantic memory has been demonstrated on a number of tasks including category fluency (Baddeley & Warrington, 1970), semantic verification (Baddeley, 1982b) and rule learning (Kinsbourne & Wood, 1975). Evidence of impairment to episodic memory is reported in the same studies on tests of recall and recognition. Additional evidence supporting the dissociation of semantic from episodic memory comes from a study on source amnesia. Schacter, Harbluk and McLachlan (1984) found that patients with severe memory impairment could recall some trivial facts they had been taught about famous people but could recall neither the source of the information nor its presentation during the experiment. Thus, knowledge of facts was available to patients but episodic knowledge, relating to the acquisition of these facts, was not available.

The main criticism of the semantic-episodic theory is that, on its own, it does not explain why amnesic patients fail to acquire novel semantic information. For example, the well-known patient HM could not acquire the meanings of words that were introduced after the onset of his amnesia (Gabrieli, Cohen & Corkin, 1983). However, this can be accommodated by concluding that only semantic knowledge acquired prior to the onset of amnesia is preserved. It is also possible that amnesic patients can acquire novel semantic information, but that this knowledge is only accessible under certain conditions. An example of this is provided by Verfaellie, Croce and Milberg's (1995) patient, SS, who acquired partial knowledge about the meaning of novel words. Evidence of new learning was only found when indirect testing procedures were used (i.e., by examining ability to verify the correct usage of a word in a sentence rather than asking about word meaning directly) and support from pre-existing knowledge was provided (i.e., learning was only found in the case of compound words — items consisting of two meaningful pre-existing words). There are other examples of patients who have shown a capacity to acquire novel semantic information under these conditions (e.g., Hirst, Phelps, Johnson & Volpe, 1988; Tulving, Hayman & MacDonald, 1991). Together, these findings suggest that amnesic patients can learn novel semantic information. While there is the additional issue of how this knowledge can be accessed, this need not be central to the semantic-episodic theory.

Even if we accept that amnesic patients can acquire novel semantic information under certain conditions, there is another problem that must be addressed concerning the relationship between the two systems. Some researchers have argued that semantic memories emerge from episodic memories (e.g., Kinsbourne & Wood, 1982). This is consistent with the observation that most information is first encountered in the context of a particular episode. However, in this case, one must either acknowledge that semantic memory is not preserved in amnesia or that episodic memory is not impaired — both of which are inconsistent with the semantic-episodic theory. According to this view, novel semantic memories cannot be created from a damaged episodic system. These memories must be supported by an episodic trace.

The opposing view concerning the relationship between these two systems is that episodic information is represented as a subsystem within semantic memory (Tulving, 1985, 1987). In such a structure semantic memories can be accessed independently of episodic memories but episodic memories must be recalled in the context of semantic memories. This view is consistent with the semantic-episodic theory insofar as it can account for the preservation of semantic memory in the context of impaired episodic memory. However, in this revised position where semantic and episodic memory do not function independently, there is no basis for claiming that one memory system is dissociated from the other in amnesia. While debate continues about the relative merits of each view, there is some consensus about the importance of resolving this issue as one means of clarifying the status of this memory systems account.

The procedural-declarative distinction

The distinction between procedural and declarative memory was introduced to explain the differentiation commonly observed in amnesic patients between performance of skills and conscious knowledge of having performed or acquired these skills. These different abilities have been attributed to different memory systems. The *procedural memory* system is believed to contain knowledge relevant to skilled behaviour and the *declarative memory* system is believed to be responsible for conscious, or explicit, recollection of information. The former ability is preserved in amnesia and the latter is impaired (Cohen & Squire, 1980).

It is generally agreed that patients acquire sufficient knowledge to support performance on skill-based tasks. Nonetheless, the distinction between procedural and declarative memory is insufficient to account for *all* the preserved abilities identified in these patients. Some residual abilities extend beyond the realm of perceptual and motor-skills. Repetition priming, which refers to the facilitation in performance as a consequence of previous encounter (see Cofer, 1967), is a good case in point. Most tests of priming provide evidence of knowledge and not of skills. The fact that amnesic patients complete word fragments with items just encountered at study (e.g., Warrington & Weiskrantz, 1974), for example, indicates that they can acquire novel information in addition to skills. Such tasks, like skill-based tasks, are performed outside of conscious awareness. Thus, it could be argued that what is preserved in amnesia is not skill-based knowledge alone, but all knowledge that can be demonstrated outside of conscious awareness. The concepts of *implicit* and *explicit* memory have been proposed to address the role of consciousness in memory performance. Tests that examine knowledge without making reference to past episodes are classified as implicit, whereas those that require conscious recollection are defined as explicit (Graf & Schacter, 1985).

In an attempt to characterize the entire range of residual abilities in amnesic patients this concept of procedural memory has been replaced with "nondeclarative" memory (Musen, Shimamura & Squire, 1990; Squire & Zola-Morgan, 1988). The declarative-nondeclarative distinction provides a systemic explanation of implicit and explicit memory phenomena. Performance on implicit (i.e., nonconscious) tasks is supported by the nondeclarative memory system and performance on explicit (i.e., conscious) tasks is supported by the declarative memory system. However, this does not fundamentally change this approach to amnesia. A dual systems explanation of the condition remains central to the revised theory. Preserved abilities are assumed to be supported by the nondeclarative memory system and impaired abilities to the declarative memory system.

There are problems in attributing all preserved abilities to one memory system. It could be argued that the various forms of unconscious memory classified as nondeclarative are quite different. For instance, it is unlikely that a single system is responsible for supporting performance on tests of skill acquisition and priming. Furthermore, there is evidence to suggest that priming and skill learning can be dissociated (Butters, Heindel & Salmon, 1990), suggesting that the cognitive and neural operations supporting performance on these tasks may differ. If these operations are genuinely distinct then it is unlikely that understanding of the amnesic condition will be advanced by nominating a catch-all concept of a "nondeclarative" system in which qualitatively different forms of memory are seen as equivalent.

Perhaps the range of preserved abilities can be attributed to the integrity of a number of different systems. The knowledge base supporting skill acquisition may be different from that supporting performance on other tests of indirect or unconscious memory. This suggestion has been made by Tulving and Schacter (1990) who argued that another memory system — the perceptual representation system — was responsible for certain implicit memory phenomena (i.e., priming). They suggested that this system operated independently of other memory systems and that it supported performance on tests such as perceptual identification and fragment completion. Thus, preservation of knowledge in amnesia could be explained by the integrity of both the procedural and perceptual representation systems. However, the introduction of new systems creates another problem. If other preserved abilities are found are we to continue to invent new systems to accommodate them? There is no consensus at this stage concerning guidelines for the acceptance of new systems and without them an overabundance of memory systems may result (see Blaxton, 1995, for a discussion).

While a dual systems approach is implied in the distinction between declarative and nondeclarative memory, this need not be the case. It is generally accepted that dual system explanations of the amnesic memory disturbance are too simplistic. Perhaps there is a single declarative memory system that is damaged in amnesia and this may be sufficient to characterize the condition. In addition though, there may be *multiple* systems responsible for the various preserved abilities observed in these patients. Given the diversity in these preserved abilities, it seems more likely that they are supported by a complex array of memory systems.

Modular/systemic accounts: Concluding comments

On superficial analysis, it seems that the two theories discussed in this section present very different views about the particular systems that are involved in the process of remembering. Yet there is in fact some degree of overlap between the theories. By definition, episodic and declarative memory systems both support conscious remembering which is impaired in amnesic patients. However, information accessed from semantic memory can either be conscious or non-conscious. For example, in response to the question "What is the capital of Australia?", the answer "Canberra" can be produced either with or without conscious awareness of how this fact was acquired. As this overlap suggests, the distinction between these memory systems is far from clear. This is complicated further by attributing all preserved abilities to a single memory system. However, apart from reasons of parsimony, there is no need to maintain a dual systems approach provided the existence of additional systems can be proven.

A final comment concerning modular theories relates to their focus on data from amnesic patients to support dissociations among memory systems. Much of the evidence in support of these distinctions is provided in the context of amnesia. This raises an interesting question. If a memory system that was created to explain preservation of ability in amnesia was subsequently found to be impaired in these patients, should this be taken as evidence against the existence of that system? Even if we do not reject a system completely on this basis then, at the very least, we might question whether it exists in the form proposed in these theories.

Process theories of amnesia

An alternative approach to theories based on damage to particular memory systems is based on the concept of differential vulnerability. This position is adopted by process theorists, who argue that the deficiency in amnesia is best explained in terms of the type of information being processed rather than the operation of different memory systems. There are two major accounts based on processing theory — one attributes the vulnerability to processing of contextual information, and the other attributing it to processing information conceptually.

Contextual memory deficit hypothesis

The role of context in normal remembering is well-established (e.g., Baddeley, 1982b; Godden & Baddeley, 1975; Thomson, Robertson & Vogt, 1982; Wiseman & Tulving, 1976) and it has been suggested that it may also be central to understanding the deficit in amnesia (Huppert & Piercy, 1976, 1978a; Mayes, 1988, 1992; Mayes, Meudell & Pickering, 1985). According to this theory, amnesic patients have difficulty processing the contextual aspects of information because this is more vulnerable to the effects of damage. If these patients cannot remember the contextual features unique to a particular event, then it is difficult to differentiate it from other similar events. The assumption made here, is that contextual and target information is processed differently.

There is considerable evidence to support the contextual memory deficit hypothesis. Huppert and Piercy (1976) investigated the influence of temporal context on memory by examining ability to differentiate pictures presented over two days. Half the pictures presented on the second day had been seen on the first day and participants were simply asked to identify the items presented on the second day. While controls had no difficulty making this discrimination, Korsakoff patients showed a tendency to identify repeated items (i.e., items presented on both days) as those seen most recently. Yet there was no difference between these groups in terms of their familiarity with target items (i.e., judging whether items had been seen before). This suggested that the patients had stored information about the materials but not the circumstances of learning.

In a subsequent study these researchers (Huppert & Piercy, 1978a) found that patients were influenced more by the strength of memory traces than they were by context — again, suggesting that contextual information is more vulnerable. This conclusion was based on the pattern of responses made by patients to recency and frequency judgements. Patients tended to confuse frequency of exposure with recency of presentation (i.e., items presented on three occasions, as compared with one, were believed to have been seen recently) and recency of presentation with frequency of exposure (i.e., items just seen were believed to have been shown on more occasions). It was suggested that amnesic patients based their judgements on the perceived strength of memory representations or familiarity rather than on specific contextual information associated with each item. While amnesic performance was influenced more by trace strength than contextual cues, controls were influenced by a combination of these factors.

A study by Schacter et al. (1984) has also been cited in support of the contextual account. Patients with severe memory impairment were asked to classify statements either based on fiction (e.g., that Bob Hope's father was a fireman) or well-known fact (e.g., that Al Capone was a gangster) as true or false. The statements had previously been read out by two experimenters, one male and the other female. While patients showed a tendency to remember the fictitious statements, they had difficulty recalling exactly how the facts were acquired. They could not specify whether the information was acquired in the course of the experiment, nor could they identify the person who had provided the information.

The contextual hypothesis has also been investigated using the A-B, A-C interference paradigm. The general procedure is to present participants with two lists of paired associates to study. The word in each pair of items contained in the first list is also used to cue a new associate in the second list (e.g., the word battle may be paired with 'soldier' in the first list and 'army' in the second list). A number of researchers have found that amnesic patients tend to produce many intrusion errors in such tasks (Warrington & Weiskrantz, 1974, 1978; Winocur & Weiskrantz, 1976). That is, when knowledge for associates in the second list is examined, patients tend to produce words they encountered in the first list. This confusion can be interpreted as a failure to utilize the contextual features unique to each list.

While these and other studies (e.g., Hirst & Volpe, 1982; Winocur & Kinsbourne, 1978) have been interpreted in support of the hypothesis that patients are deficient in processing contextual information, there are some general issues that require clarification if this account is to maintain its relevance as an explanation of amnesia. A major difficulty, which has yet to be dealt with appropriately, is how to define context. In attributing the deficit in amnesia to contextual processing we need to specify whether the deficiency is generalised or targeted at certain aspects of context.

One answer to this question was offered by Baddeley (1982a) who suggested two ways in which context could influence memory. Interactive context (also referred to as intrinsic context) has a direct influence on how the information is stored and remembered. In this way, the process of pairing one word with another alters interpretation of these items as a consequence of their interaction. Extrinsic (or spatio-temporal) context refers to background information that has no impact on interpretation of target information. This includes features such as environmental factors (e.g., time and place) and a person's internal state (e.g., mood state). One could argue that extrinsic contextual knowledge is an aspect of episodic memory as the latter also contains information about temporal context. The only difference between these concepts is in their theoretical framework — one is based on a processing view of memory and the other is based on a modular view of memory.

The intrinsic-extrinsic breakdown has been of limited value in clarifying the role of context in amnesia. Mayes et al. (1985) suggest that an analysis of the amnesic condition in terms of intrinsic context is inappropriate. They argued that, by definition, intrinsic context should be processed as effortfully as target information. If this were the case, then it would be difficult to sustain an analysis that is based on differential processing of contextual and target information.

Furthermore, although the notion of extrinsic context is accommodated better within an account based on differential processing, deficient processing of temporal information has also been reported in patients with lesions to frontal regions (e.g., Petrides & Milner, 1982). This is problematic for the contextual deficit theory, because much of the supportive evidence is based on results of studies conducted with Korsakoff patients who are known to have a combination of executive (i.e., frontal lobe) and memory deficits (see Kopelman, 1995). If the deficit is observed in both memory impaired and frontal patients, then deficient processing of background features may be a secondary consequence of the amnesic condition.

Another related problem with the contextual account concerns the differential processing of context and target information. It is not clear why contextual information would be more vulnerable to damage than target information. In response to this, it might be argued that the availability of processing resources is reduced in amnesic patients. As a consequence, some information, would be ignored as this lies in the periphery of attention and requires minimal effort (Mayes, 1988; Mayes et al., 1985). However, this analysis is difficult to maintain when contextual information is more salient than target information (e.g., when a fire alarm goes off in the middle of learning a word list). Perhaps some variant of the account offered by Mayes and his colleagues may ultimately provide an explanation of the selective vulnerability of contextual information, but this seems unlikely without further refinement of the concept of extrinsic or background context.

Conceptually-driven and data-driven processes

The distinction between conceptually-driven and data-driven processing has been offered as an alternative, process-based, interpretation of the implicit-explicit memory dissociation (a modular explanation was considered earlier in discussion of the declarative-nondeclarative distinction). Here it is argued that the dissociation observed on tests of implicit and explicit memory reflects differences in their dependence on depth of processing. Performance on implicit memory tests requires data-driven processes, which are believed to be preserved in amnesic patients, and performance on explicit memory tests requires conceptually-driven processes which are impaired (Blaxton, 1992).

The role of these two processes is clarified by Jacoby (1983). Conceptually-driven processes are believed to be engaged in tests which involve elaborate, or semantic, analysis of stimulus materials. Data-driven processes are engaged in tests which require analysis of the perceptual attributes or surface features of stimulus materials. Process theorists suggest that there is a confound in many tests of implicit and explicit memory (see Gabrieli, 1995). It is argued that most tests of implicit memory typically involve data-driven processes while most tests of explicit memory involve conceptually-driven processes. Thus, the implicit-explicit dissociation may be caused by an underlying deficit to conceptual processing. According to this view, amnesic patients should be impaired on any memory test that requires conceptual processing, irrespective of whether it is implicit or explicit in nature.

While much of the evidence used to support this theory is based on data from non-clinical populations, there is some limited evidence from memory-impaired patients. For example, Blaxton (1992) examined the impact of conceptual and data-driven processes on both implicit and explicit tests in a group of patients with temporal lobe epilepsy. She tested their memory for studied words using four tasks — an implicit perceptual test (i.e., word-fragment completion), an implicit conceptual test (i.e., answering general knowledge questions pertaining to words presented at study with no reference to the previous study episode), an explicit perceptual test (graphemic cued recall) and an explicit conceptual test (semantic cued recall). Her findings were consistent with predictions generated from the processing account of memory. These patients were impaired on both implicit and explicit tests that were conceptual in nature.

However, there is also evidence to the contrary. That is, there is evidence of preserved conceptual processing in amnesia on implicit but not explicit memory tests. Shimamura and Squire (1984) found that amnesic patients were just as likely as controls to produce words encountered at study when asked to generate the first semantic associate that came to mind in response to a cue. Clearly, this task requires more than a superficial analysis of stimulus features. A similar pattern of results was reported by Graf, Shimamura and Squire (1985). These researchers presented amnesic patients with a random list of words and then asked them to produce the first eight items they could think of in response to a category label. Amnesic patients showed a tendency to generate words they had encountered at study at a level similar to that found in controls. These and other reports of preserved conceptual processing in amnesia (e.g., Keane, Gabrieli, Monti, Cantor & Noland, 1993) are not consistent with predictions generated from the processing account. Thus, it appears that in these cases the implicit-explicit framework provides a more convincing explanation of the pattern of preserved and impaired abilities in amnesia.

In summary, the processing view has been very successful in explaining the memory dissociations observed in normal individuals (e.g., Blaxton, 1989; Roediger & Blaxton, 1987; Roediger, Weldon & Challis, 1989; Srinivas & Roediger, 1990). However, the evidence from memory-impaired populations is far from convincing. While Blaxton (1992) provides some clinical evidence to support the processing account, there is in fact more evidence against it. It is apparent then, that the differentiation between conceptual and data-driven processes alone is not sufficient to account for the pattern of preserved and impaired abilities in amnesia. Reference to retrieval mechanisms — that is, whether information is retrieved with or without conscious awareness — is also required.

Process accounts: Concluding comments

It is obvious that the type of processing engaged when performing a task has an impact on performance. Manipulating the processes engaged at encoding and retrieval, for example, has a considerable influence on how much information is remembered (Tulving, 1979; Wiseman & Tulving, 1976). Irrespective of whether the focus is on clinical or non-clinical populations, these processes have an essential role in memory function.

Having said this, it seems illogical to consider process and systems theories independently. If there is a special system responsible for storing our general knowledge then it is likely that different processes will impact on the information that can be retrieved. For example, in a case of amnesia, it has been shown that the processes engaged during recall and recognition are not sufficient to retrieve knowledge about the meaning of novel words. However, when that knowledge was tapped indirectly, by using other tasks (which presumably engage different processes or mechanisms), some information about word meaning was accessed (Verfaellie et al., 1995). Both theories can be used to explain this result. Novel information was acquired and, according to a systems account, this information would be stored in semantic memory. Furthermore, this information could only be retrieved when certain processes were engaged. This approach, in which the merits of both systems and process theories are considered, may be more progressive as each perspective has something to offer in understanding memory function.

Stage theories of amnesia

Regardless of whether we accept systems or process accounts of amnesia, we can ask whether the deficit is located at a particular stage of information processing. That is, if amnesia is a deficit in episodic memory does the problem arise at encoding or retrieval? The stages traditionally distinguished in analysis of remembering comprise encoding, storage/consolidation and retrieval. These stages coincide with the theoretical distinctions between immediate short-term memory and long-term memory which are supported both behaviourally and biologically (see Squire, 1987 for a discussion). Behaviourally, there is considerable evidence supporting the differentiation between short-term and long-term memory largely based on studies with amnesic patients (e.g., Baddeley & Warrington, 1970) and normals (e.g., Baddeley, 1966a, 1966b). Additionally, there is evidence of synaptic change in the transfer of information originally encoded in short-term memory to that consolidated in long-term memory (e.g., Kandel & Schwartz, 1982). Thus, these hypothetical stages involved in remembering have a direct empirical basis.

Encoding/retrieval

Encoding refers to the initial perception and formation of memory representations and retrieval refers to processes involved in accessing stored information. However, in practice they are difficult to differentiate. It is difficult to dissociate encoding from retrieval deficits on the basis of responses provided in most tests of memory. If patients complete word-stems with items encountered at study but cannot discriminate studied from non-studied items on tests of recognition, is this due to poor encoding of information at the time of study or inadequate retrieval of information from an intact knowledge base? These possibilities are difficult to tease apart as there is considerable interaction between these two stages of processing (Kinsbourne & Wood, 1982; Mayes & Downes, 1997). For this reason, theories that attribute the memory dysfunction in amnesia to deficient encoding and retrieval will be considered together (although there is some suggestion that these two processes can be differentiated under conditions of divided attention (Craik, Govoni & Mosche, 1996), this has not been applied to amnesia). There are two main encoding/retrieval deficit theories. One attributes the deficit in amnesia to processing of semantic information at the time of encoding and the other to interference during retrieval.

The view that amnesic patients cannot *encode* information appropriately has been proposed by numerous researchers and one common version of this theory is the proposal that encoding of semantic information is deficient (Butters & Cermak, 1975; Cermak, et al., 1973; Cermak & Moreines, 1976). It is suggested that the memory breakdown in amnesia results from an inability to encode information at a sufficiently deep level. This position is reminiscent of Craik and Lockhart's (1972) levels-of-processing account in which it is argued that deeper levels of analysis strengthen memory traces. If amnesic patients cannot process information at a sufficiently deep level then the memory traces that are formed will be relatively weak and thus unable to support performance on tests of recall and recognition.

Evidence of deficient semantic encoding is provided by Cermak and Moreines (1976), who found that Korsakoff patients were particularly impaired in detecting items in a word list from the same semantic category. In comparison, their ability to engage in shallow processing, such as detecting items on the basis of rhyme and repetition, was relatively unimpaired. Investigations of proactive interference (PI) have also been used to support the semantic processing hypothesis. Cermak, Butters & Moreines (1974) investigated release from PI using tasks requiring superficial analysis (i.e., shifting from letters to numbers or vice versa) and semantic analysis (i.e., shifting from animals to vegetables or vice versa). Korsakoff patients demonstrated a release from PI under conditions of superficial processing but there was no such release under conditions of semantic processing. Because controls showed release under both conditions, it was argued that the patients' failure to shift in the deep analysis condition indicated that they could not encode information semantically.

If the deficit in amnesia can be isolated to semantic analysis at the time of encoding, then improvement in memory performance should be observed by encouraging patients to process information semantically. Unfortunately, the evidence does not support this claim. Meudell, Mayes and Neary (1980) induced patients to process information at a number of levels ranging from shallow (i.e., spotting the difference between cartoons) to deep (i.e., describing cartoons).

With this manipulation a levels-of-processing effect was found in amnesic patients. However, patient performance at all levels of processing was below that of controls. This suggests that amnesia is not due to deficient semantic analysis alone.

There is also a confound in investigations of PI. Most of these studies have been conducted with Korsakoff patients and it is possible that deficient semantic analysis results from impairment to functions other than memory. There is evidence of a failure to release from PI in patients with frontal lesions (e.g., Moscovitch, 1982), and this region is known to be implicated in patients with the alcoholic Korsakoff syndrome (Kopelman, 1995). If the failure to release from PI is secondary to the amnesic condition in Korsakoff patients, then much of this evidence can be discounted. Having said this though, there is evidence of normal release from PI in Korsakoff patients under certain experimental conditions. It has been shown when advance warning of the shift in taxonomic category is provided (Winocur, Kinsbourne & Moscovitch, 1981), when a certain number of learning trials are used (Kopelman, 1991) and on the first occasion of a shift in category (Freedman & Cermak, 1986). These findings highlight the fact that the relationship between the presence of frontal dysfunction and the failure to release from PI is far from clear.

Retrieval theories state that the deficit in amnesia lies in accessing representations from memory. If such a theory is to explain AA, the deficit must be restricted to retrieval of newly acquired information. In addition, some types of information must be more vulnerable than others, because we know these patients can remember some information better than others. One suggestion is that at the time of retrieval amnesic patients are highly sensitive to competing memory traces and that the resulting interference reduces memory performance (Warrington & Weiskrantz, 1970, 1974). This would account for differences in amnesic performance on tests of priming and free recall. The priming tests provide partial cues, reducing the impact of irrelevant memory trace, while free recall does not.

Again though, the evidence in support of this proposal is limited. For example, in a study conducted by Warrington and Weiskrantz (1978), patients were asked to learn words from two lists. All words presented in the first list had a competing item in the second list which consisted of the only other word that shared the same first three letters (e.g., if cyclone was presented in one list, cycle was presented in the other). These researchers found no difference in performance between amnesics and controls in recall of items from the initial list and the first trial of the second list. Furthermore, no difference was found between groups in a follow-up study in which participants were asked to produce items from both lists in response to cues. These results raise doubts about the appropriateness of the interference hypothesis as an explanation of the deficit in amnesia.

Although the particular versions of encoding/retrieval theories discussed here appear to have limited value, there may be no need to discard such theories altogether. The evidence suggests that it is unlikely the deficit is restricted to semantic analysis alone or interference from competing traces. However, it is possible that another type of information (for example, contextual information) is more vulnerable at these stages.

Storage/consolidation

It has also been suggested that amnesia may be caused by a deficiency in storage. This might result from poor consolidation or from rapid decay.

Consolidation refers to a process by which temporary memory representations gradually become relatively permanent or less resistant to disruption (Squire, 1987). During this process of transfer to more permanent storage information is modified or reorganized. In amnesia, it has been suggested that patients fail to consolidate information appropriately (e.g., Squire, Knowlton & Musen, 1993). It is argued that if patients cannot consolidate information, then it is difficult for them to recall that information some time later. However, as consolidation is an ongoing process, it is difficult to locate the deficit in a particular stage (i.e., initial or later) of transfer to long-term memory.

The consolidation deficit in amnesia, although originally proposed to explain various features of RA, might take several forms. On the one hand, deficient consolidation might result in the formation of weak memory traces which are only sufficient to support performance on certain tests. For instance, most tests of implicit memory (e.g., fragment completion, perceptual identification) provide some cues about the information to be remembered. This information may be sufficient to support performance even if the memory trace is weak. In contrast, many tests of explicit memory involve free recall of target and contextual information and a weak trace alone may not be sufficient to support performance in this case. It is also possible that particular types of information, such as context, are not consolidated. As a result, a failure in memory may occur. If the stored information contains no uniquely defining features it may easily be confused with other memory traces. Either of these explanations could account for much of the behaviour of amnesic patients.

Another possible explanation for the storage deficiency in amnesia is that memory traces, which are acquired normally, decay rapidly. This type of explanation would be consistent with observations of amnesic behaviour in everyday situations. For example, while patients retain sufficient information in the short-term to enable normal conversation, traces of the circumstances and content of the conversation appear to degrade rapidly and the patient eventually fails to recall that any conversation had ever taken place. However, the evidence in support of the rapid decay theory is not conclusive. Some researchers have found evidence of faster forgetting in amnesic patients, but only under restricted conditions — that is, at particular delays, on some tests and with certain materials. For example, Kopelman and Stanhope (1997) found evidence of rapid forgetting over a 10 minute delay in a free recall test examining memory for pictures and objects. Yet no difference was found between amnesic patients and controls in recognition and cued recall. Similarly, Carlesimo, Sabbadini, Fadda and Caltagirone (1995) found normal rates of decay in yes/no recognition when memory for pictures was examined and accelerated forgetting over a 15 minute delay in free recall of words.

There is also evidence that opposes the rapid decay theory. Warrington and Weiskrantz (1970) compared retention of information after a brief delay (i.e., 1 minute) in amnesic patients and controls. A fragment completion test was used in an attempt to equate initial memory performance in the two groups. They found no difference in forgetting rates, seemingly contradicting the rapid decay theory. However, interpretation of results was complicated by the fact that the initial learning performance of amnesic patients was still below that of controls. The problem of equating initial learning levels was addressed in a subsequent study conducted by Huppert and Piercy (1978b). To control for initial learning levels these researchers manipulated stimulus inspection times. Controls were shown the materials for a period of 1 second and this duration was increased to 4 and 8 seconds for Korsakoff patients. These exposure durations had been shown in a previous study (Huppert & Piercy, 1977) to approximately equate amnesic and control performance. Under these conditions, Huppert and Piercy found no evidence to support differential rates of forgetting in patients over delays of 10 minutes, 24 hours and 7 days on tests of yes/no recognition. However, all participants in these experiments happened to be Korsakoff patients, and while they show a normal rate of forgetting it is still possible that memory traces might decay rapidly in other amnesic pathologies. But, several studies comparing forgetting rates in medial temporal, diencephalic and normal participants report no differences between these groups on tests of recognition memory (Kopelman, 1985; McKee & Squire, 1992).

It seems that rapid forgetting might only be detected on tests of free recall. If this is the case, then it could be argued that rapid forgetting is largely a phenomenon of testing and thus, on its own, does not constitute an adequate explanation of amnesia. However, deficient consolidation remains a possibility. The consolidation account may take several forms depending on the area of the vulnerability implicated. Both the trace strength (i.e., development of weak memory traces) and material specificity (e.g., a failure to consolidate context) perspectives are capable of accommodating many of the phenomena observed in amnesic patients. In fact, these two theories need not be considered as incompatible. Both factors together (i.e., reduced trace strength for contextual information) could be operating to generate the memory disturbance in amnesia.

Stage theories: Concluding comments

There is no evidence that completely rules out any of the stages involved in remembering. The deficit could occur at encoding, storage, retrieval, or a combination of these stages. But a comprehensive stage theory must identify the specific nature of the memory loss in addition to the stage at which this occurs. In fact, the most plausible stage theories incorporate information loss (i.e., systems accounts) and vulnerability (i.e., process accounts) accounts. As this integrative approach suggests, theoretical accounts need not be considered in isolation.

2.3 Overview

The body of literature on amnesia is too vast to address within the confines of a single chapter. The above review presents only a selective treatment of the main contributions that researchers have made in the course of attempting to understand both this condition and memory function in general. There is some agreement about the characteristic features of the amnesic syndrome, most notably in the anterograde form of the disturbance. However, there is considerable dissatisfaction with theoretical explanations of the amnesic memory disturbance.

The problem with amnesia is that all accounts, whether they address RA or AA, and whether they provide a process- or systems-based explanation, explain only some of the phenomena observed in patients who suffer from this condition. Consequently, no single account adequately explains amnesia. Nevertheless, some accounts survive scrutiny better than others. Investigations of amnesia have raised numerous questions. For instance, to what degree does the memory disturbance in amnesia differ as a function of pathology? Are several stages of information processing implicated in producing amnesia? Is there a problem in remembering contextual and target information, and if so, is this due to a deficit in processing either source of information (e.g., selective impairment in processing contextual information) or associating them? Is the deficit (or deficits) responsible for producing AA similar to that in RA? At this stage these and many other questions are unresolved.

The primary aim of all empirical work conducted with amnesic patients is to gain a better understanding of memory function. In addressing this general question there has been considerable variation between studies mainly reflecting the various theoretical perspectives of researchers. Much of this research has been limited by a tendency to focus on the amnesic syndrome in isolation. Amnesia is not the only condition which bears on the question of memory structure. Yet there seems to be little interaction between the theoretical accounts addressed in different pathologies. Amnesia should be considered in the context of other clinical conditions which produce memory impairments. In the following chapter a link is made between patients suffering from certain forms of dementia and amnesia. This is based on an apparent similarity in performance on tests of higher-level categorical knowledge.

Chapter 3

Preservation of memory for generalities: A review of findings from dementia and amnesia

The general question addressed in this thesis concerns preservation of memory for generalities and, in particular, its relevance to understanding amnesia. As alluded to in previous chapters, *preservation of memory for generalities* refers to a pattern of performance in which exemplar knowledge is impaired relative to higher-level categorical knowledge. This pattern of performance was reported initially by Warrington (1975) in three patients suffering from dementia, in whom the primary deficit was a selective impairment to semantic memory. All patients demonstrated a residual capacity to provide superordinate categorical information for items they could neither describe nor define in detail. Over time, evidence of this dissociative phenomenon in certain forms of dementia (i.e., semantic dementia and Alzheimer's Disease) accumulated and this in turn has led researchers to seek an explanation for the phenomenon. Several theoretical accounts have been offered to explain memory for generalities in dementia — one based on the hierarchical structure of semantic memory (Collins & Quillian, 1969), another based on item familiarity and frequency (Funnell, 1995) and a final explanation based on random degradation of semantic knowledge (Hodges, et al., 1995).

Since investigations of the generalities phenomenon have focused exclusively on patients suffering particular forms of dementia, one might suppose that it is restricted to these patients alone. However, there are indications of an apparent differentiation between exemplar and higher-level knowledge in another group of patients — namely, global amnesics. In the case of retrograde amnesia, results from several patients suggest preservation of higher-level knowledge about famous people (Hodges & McCarthy, 1993; McCarthy & Warrington, 1992; Warrington & McCarthy, 1988). A similar pattern of partial knowledge preservation is apparent in the performance of anterograde amnesics on tests of artificial grammar learning (Knowlton, Ramus & Squire, 1992; Knowlton & Squire, 1994, 1996), vocabulary acquisition (Verfaellie et al., 1995) and memory illusions (Cermak et al., 1973; Schacter, et al., 1996). Although results of these studies could be interpreted as evidence of preserved memory for generalities in amnesia, this phenomenon was not the primary issue investigated in these papers. A recent study conducted by Haslam et al. (1997) addressed this issue directly. These authors suggested that their findings indicated differential performance on tests of exemplar and categorical knowledge in global amnesia.

This chapter reviews evidence from both dementia and amnesia literatures relevant to the generalities phenomenon. The dementia literature is addressed first since this represents both the original source and the most thorough examination of the phenomenon to date. This is followed by a discussion of some relevant studies of anterograde and retrograde amnesics. The evidence is of two types — one in which higher-level knowledge has been examined directly (e.g., investigations of category learning in amnesia) and a second where evidence of higher-level knowledge has been an indirect outcome of the investigation. Reported evidence of residual learning in amnesics is considered from the alternative perspective of preserved memory for generalities in amnesia. Finally, the results of the study conducted by Haslam et al. (1997) are discussed in detail. This study examined higher-order knowledge relative to item-specific knowledge and was the first to apply an explanation based on preserved memory for generalities in the context of amnesia.

3.1 Preservation of memory for generalities in dementia

3.1.1. Evidence

Much of the research relevant to the generalities phenomenon in dementia has addressed a fundamental question concerning our knowledge about concepts. Of particular interest to researchers has been the composition of concepts, including their characteristic features and representation. For instance, how is knowledge about dingoes organised so that we can distinguish them from dogs and cats, identify dogs as more closely associated with dingoes, and classify them all as mammals? The dissociation of higher-level category knowledge from exemplar knowledge observed in patients suffering from particular forms of dementia has been seen as providing a means to address such questions.

Warrington's (1975) report of partial knowledge loss in patients with selective impairment of semantic memory was the first in a series of papers noting differential performance on tests of exemplar and higher-level category knowledge. Warrington presented profiles for three patients, all of whom suffered from some form of dementia which was characterized by anomia as well as impaired word recognition and comprehension. Despite their inability to identify words and objects precisely, the patients retained sufficient knowledge about the items to make broad categorical distinctions. For example, on object recognition tests they could discriminate animals from plants and insects from non-insects reasonably well. However, when these patients were asked to make more refined judgements (e.g., to identify the dangerous animal), their performance declined. Similar results were obtained when knowledge about animal and object names was examined. Warrington concluded that knowledge of particular concepts was not completely lost in these patients. Rather, the pattern of loss was characterized by preservation of knowledge at the superordinate level and impairment of knowledge for specific attributes represented at the subordinate level.

In two of the three cases reported by Warrington (1975), the underlying pathology responsible for producing the dissociation between exemplar and higher-level knowledge was unknown, but in more recent studies it has become apparent that the phenomenon occurs in various forms of dementia. The same dissociation has been reported in patients suffering from Alzheimer's disease (AD). Martin and Fedio (1983) found that these patients showed a greater tendency to produce within-category errors (e.g., calling a 'camel' a goat) or generalisations (e.g., calling a 'pelican' a bird) when the specific name for an item was unavailable. In each case patients demonstrated some residual knowledge of items. Martin (1987) reported further evidence of impaired exemplar knowledge in two patients on a test of fluency requiring naming of items which could be found in a supermarket. Patient G produced few specific items and tended to use category labels (i.e., fruits and vegetables). Patient W produced category labels only. This performance was quite unlike that of normal controls who provided many specific items within numerous categories. In another task Martin (1987) asked a group of patients with AD to sort pictures, name them and then answer a series of questions probing superordinate, category and attribute knowledge. Patients sorted pictures into categories as well as controls and responded accurately to questions examining superordinate and category knowledge. However, numerous errors were produced on tests of naming and attribute knowledge. There was a high correlation between performances on these tasks indicating that the same patients tended to make both types of error. In this way patients demonstrated they had sufficient knowledge about concepts to respond accurately to tasks probing higher-level information. A deterioration in performance was only noted on those tasks that tapped more specific subordinate detail.

Semantic dementia is another clinical condition in which a differentiation between exemplar and higher-level category knowledge has been identified. These patients suffer from a progressive aphasia characterized by selective impairment to semantic memory and general knowledge with relative preservation of other aspects of language output as well as other cognitive skills (Hodges, Patterson & Tyler, 1994). In addition though, there appears to be a pattern in the deterioration of semantic memory such that higher-level knowledge is preserved relative to item-specific knowledge. Hodges et al. (1994) reported the progressive deterioration in semantic knowledge observed in a patient with semantic dementia as a function of the level of specificity in sorting tasks. The patient, PP, was flawless in sorting pictures according to the living/non-living dimension, above chance (i.e., 72%) in sorting pictures on a categorical basis (e.g., land animals versus birds) and most impaired (i.e., 42%) in sorting pictures according to specific attributes (e.g., native versus foreign). A year later PP retained her ability to make the most general of these judgements, but her performance fell to chance in the second year of follow-up.

Hodges, Graham and Patterson (1995) provided a more extensive longitudinal investigation of another patient, JL, diagnosed with semantic dementia. JL was tested over a period of two years on a number of semantic memory tests. These tests examined category fluency (ranging from general to more specific categories in both living and non-living domains), picture naming, naming to verbal description, picture sorting (again ranging from superordinate to subordinate levels), word-picture matching, knowledge of semantic features and item description. JL's performance declined progressively over the two year period and a pattern of differential deterioration was noted on a number of tests which examined exemplar and higher-level knowledge. On initial examination of category fluency, the main difference in performance between controls and JL occurred for specific categories (e.g., musical instruments, sea creatures): the number of items produced by JL in the two most general categories was within the normal range but that in the two specific categories was outside of the normal range. In picture sorting, JL's ability to perform superordinate (i.e., living/non-living) judgements was preserved throughout the assessment period. Category judgements (e.g., land animal/sea creature/bird) were more accurate than subordinate judgements (e.g., British/foreign) in the first year of follow-up, but performance on both fell dramatically in the final year of assessment. An examination of naming errors for items originally identified correctly revealed that early errors always reflected some preservation of knowledge. These initial naming errors consisted largely of within-category responses (or category co-ordinates) or superordinate category labels. JL's responses on these tests indicate that he had retained some of his knowledge about concepts, at least initially, and that this was sufficient to support performance on tests of higher-level judgement.

Funnell's (1995) investigation of the memory disturbance in a case of semantic dementia is also worth noting. In a series of experiments, she examined the impact of item familiarity and frequency on exemplar and higher-level category knowledge. This approach reflects Funnell's belief that the dissociation between knowledge levels results from variations in word familiarity and frequency. Her patient was asked to define superordinate and basic-level names which ranged in familiarity and frequency and also to specify and verify object properties. She found that the patient could define concepts at all levels of knowledge (i.e., superordinate, basic-level and property-level) provided they were highly familiar and common. On this basis, Funnell concluded that the breakdown in semantic memory was not characterized by differences between levels of conceptual knowledge but, rather, reflected the differential strength of memory representations associated with differences in item familiarity and frequency.

Funnell's paper is not the only one which questions whether the generalities phenomenon primarily reflects a differentiation between exemplar and higher-level knowledge. Nebes and Brady (1988, 1990) raised the possibility that the differential performance may result from differing task demands. They suggested that tests of item-specific knowledge may be more demanding than tests of categorical knowledge. In the first of these papers (Nebes and Brady, 1988), they asked patients with AD to determine whether a target item (a line drawing of an object together with its name) and a set of stimulus words were associated. Decision time was used as an indirect measure of semantic knowledge. Ten stimulus words were presented after the target item was shown. Half of the words were related to the target and half were unrelated. Related words consisted of the object's superordinate category, an action or function of the object, a physical feature, a general associate and the name of the test object. For example, if the target item was "shirt", then the related words comprised clothing, wear, collar, tie and shirt. The authors found no differences in reaction time to category and attribute words suggesting, in contrast to the findings reported in earlier papers, equal knowledge at general and specific levels. Nebes and Brady concluded that attribute knowledge was not selectively damaged in patients with AD. Rather, they suggested that direct responses to questions about attributes requires conscious evaluation of concepts and that this is more demanding than an indirect association task. Accordingly, what appears to be a loss of specific semantic knowledge may be no more than a deficit in cognitive processing.

A similar argument that differential performance on tests of exemplar and categorical knowledge is due to task difficulty is presented by Bayles, Tomoeda and Trosset (1990) and Cox, Bayles and Trosset (1996). These authors referred to examples of tasks in Warrington's (1975) original paper to illustrate their point. They argued that the questions used to evaluate superordinate knowledge (e.g., "Is it a bird?") were simpler than those used to examine subordinate or attribute knowledge (e.g., Is it bigger than a cat?"). In these circumstances it would not be surprising to find patients experiencing greater difficulty with the latter tasks as they require knowledge of two concepts rather than just one. To evaluate the influence of task difficulty, Bayles et al. (1990) used the same concepts to examine item-specific (i.e., naming task) and higher-order knowledge (i.e., using category recall and category recognition) in patients with AD and normal controls. They found that the relative difficulty of category to naming performance increased with dementia severity and that when this was controlled, naming became progressively easier.

The Bayles et al. (1990) study can be criticised for basing measurement of attribute knowledge on a single and possibly inappropriate measure (i.e., a confrontation naming task). This problem was addressed in a subsequent study by Cox et al. (1996) who asked patients to identify attribute differences, sort items into categories, define concepts (both category and attribute) and to name items. The inclusion of all these tests ensured that category and attribute knowledge was sampled using a range of measures. Again the same items were used across tasks and effects of task difficulty were controlled. The results were somewhat inconsistent, but it is possible that limitations in the analysis of their data contributed to this. For instance, the decline in performance with increasing severity of dementia (measured by the Mini-mental State Exam) was greatest on the attribute differences task. This is consistent with patients having the greatest deficiency in attribute knowledge. Yet no differences in deterioration rates were found when performance on attribute and category definition were compared. An analysis of item-consistency might have been useful here — that is, whether accuracy in category definition corresponded with accuracy in attribute definition. It is possible that there was a high degree of consistency in responding, implying that individuals could either access substantial knowledge relevant to a particular concept or none at all. If there was inconsistency it would have been useful to determine whether performance on category and attribute definitions differed, and if so, in which direction. Additionally, it is possible that these tasks measured different abilities. In this case comparison is meaningless. Given these limitations it is difficult to draw any firm conclusions about the nature of semantic memory deterioration either from this study or that of Bayles et al. (1990).

The studies reviewed above are not the only investigations in which differences on tests of attribute and category knowledge have been reported in dementia (e.g., see Chertkow, et al., 1992; Chertkow, Bub & Seidenberg, 1989; Warrington & Shallice, 1979). In fact, there is considerable evidence in support of differential performance on tests of exemplar and categorical knowledge. Nevertheless, questions remain as to how the phenomenon should be characterized and explained. Is the phenomenon to be seen as a differentiation between item-specific and higher-level knowledge, or between low and high levels of concept familiarity/frequency? Is the pattern of semantic memory deterioration a function of selective vulnerability (either in attribute knowledge or in concepts low in familiarity/frequency) or random damage? Theoretical accounts addressing these questions are reviewed in the next section.

3.1.2. Theory

Three explanations have been used to account for the generalities phenomenon in dementia. These comprise the hierarchical network model, the familiarity/frequency account and the fragmentary knowledge account.

The hierarchical network model

The first explanation of the differential performance between category and exemplar knowledge is based on Collins and Quillian's (1969) hierarchical network model of semantic memory. In the hierarchical structure envisaged by this model concepts are represented as "nodes". There are also associations between concept nodes stored at different levels reflecting the fact that some concepts are superordinates (e.g., animal) or subordinates (e.g., emu) of others. Nodes are associated (i.e., linked) with a number of properties at each level. To ensure economy of representation, properties relevant to a particular concept are stored at the highest level of generalization. So, as illustrated in Figure 3.1, the property "breathes" is stored with the concept animal rather than with all specific types of animals. Thus, the hierarchy proposed is one in which the properties

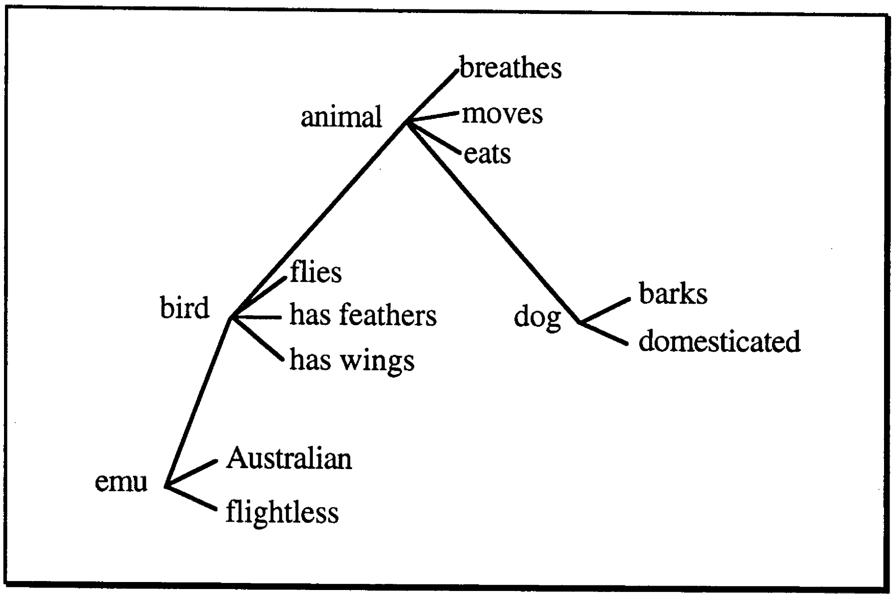

Figure 3.1 Illustration of a hierarchical semantic network structure of the type proposed by Collins and Quillian (1969).

range from being general to increasingly more specific. It is also assumed that retrieval of information from such a structure takes time and that this is a function of the number of levels that must be traversed in order to locate the relevant details.

This model appealed to researchers involved in early investigations of the generalities phenomenon in dementia (e.g., Warrington, 1975; Warrington & McCarthy, 1983; Warrington & Shallice, 1979). With this model, the pattern of knowledge loss in dementia could be explained in terms of a loss of nodes at lower-levels in the hierarchy. However, an explanation in these terms required a modification of one of the central assumptions of a hierarchical semantic network. This concerned the point of entry in a taxonomic hierarchy. In Collins and Quillian's model this is proposed to be at the level of item-specific information. So, for example, one accesses information that a dog breathes from the animal node *after* having identified it as a dog. Yet because lower-level knowledge of this type is unavailable to dementia sufferers, such an assumption clearly cannot be incorporated into explanations of the generalities phenomenon in dementia. Noting this shortcoming, Warrington (1975) suggested that the point of entry into a taxonomic hierarchy might be at the highest or most general level. Thus, one may retrieve the knowledge that a dog breathes by first accessing the fact that it is living, then that it is an animal at which level the particular attribute in question is stored. With reference to this retrieval process the pattern of semantic memory deterioration observed in these patients could be explained by the selective vulnerability of attribute knowledge contained at lower levels of taxonomic hierarchies (i.e., a bottom-up theory of semantic memory deterioration). For example, we may retain the connection between emu and bird but lose the specific attributes associated with the former property set.

A number of fundamental problems have been identified both with Collins and Quillian's hierarchical model and Warrington's reformulation. As noted earlier, one of the major premises of the model is that verification of properties takes time and that the time involved is determined by the number of levels that must be searched to recover the answer to a particular question (e.g., does a dog breathe?). Collins and Quillian (1969) used a sentence verification task to test this prediction. They found that the time taken to judge the accuracy of statements increased as the number of postulated levels between the concept and the relevant property increased (e.g., "a poodle is a poodle" is verified faster than "a poodle is a dog" both of which would be verified faster than "a poodle is an animal"). However, it was subsequently found that some atypical examples of concepts took longer to verify (Rips, Shoben & Smith, 1973). For instance, verifying the association between dingo and dog would take much longer than verifying the association between poodle and dog, although the number of levels involved in these two cases was the same. Additional problems emerged with the finding that some concepts do not have clearly defining attributes (Barsalou, 1987; McCloskey & Glucksberg, 1978).

The modified hierarchical model proposed by Warrington and her colleagues can also be criticized. In any model of semantic memory structure it is important to specify the processes involved both in entering the knowledge base and in differentiating concepts. These processes are unclear. Specifically, how do we enter the knowledge base at the level of "living" when provided with the concept "dog"? It is difficult to envisage a system that would allow entry at the level of "living" without initial association of that concept with "dog". If the processes involved in entering the knowledge base can be explained, there is the additional problem of differentiating concepts at progressively lower levels (see Rapp & Caramazza, 1989). How, for example, does one differentiate between trees and dogs if they have a common overriding entry point at the level of living things? Furthermore, one of the assumptions of such a model is that performance on tests of categorization provides a direct indication of the actual contents of semantic memory. In other words, accurate classification of a dog as an animal indicates that the information contained in semantic memory concerning this concept is the attribute "animal" and perhaps other more superordinate attributes (e.g., living). However, such an assumption is not a necessary requirement. A random combination of both general and specific attributes (e.g., that a dog has fur, legs, breathes and barks) could also produce a pattern of differential performance on tests of general and specific knowledge (see the fragmentary knowledge account below). Together, these criticisms of both the hierarchical semantic network model and Warrington's reformulation have led researchers to seek alternative conceptualizations of semantic memory structure to account for the dissociation between exemplar and categorical knowledge.

The familiarity/frequency account

As noted earlier, Funnell (1995) has suggested that the differential performance observed on tests of attribute and category knowledge can be explained by a familiarity/frequency account. She claims that category-level information is both more familiar and more frequently encountered in language and as a result acquires greater representational strength than specific attribute-level information. That is, items higher in familiarity/frequency are argued to have increased representational strength and this strength is postulated to enhance their resilience when brain structures are damaged. Tippett, McAuliffe and Farah (1995) used computer simulation to model this suggestion. They trained a network to produce names in response to a visual stimulus — the computer equivalent of a confrontation naming task. The network was trained to associate patterns of activity between visual, semantic and name units. Essentially, it was trained to produce a "name" pattern when presented with a "visual" pattern via a set of "semantic" patterns. Half of the semantic pattern contained category-based information (which was shared by a number of items), while the other half contained item-specific information. After the semantic units were damaged randomly, the authors found that their network produced more within- than between-category errors. This is the same pattern of responses produced by patients with AD on confrontation naming tasks.

Tippett and her colleagues conducted a second simulation to determine whether the greater frequency of within-category errors was due to semantic confusion (between items that shared similar semantic components) or to the increased robustness of category-based information. The semantic units were again damaged randomly and comparison of the categorical and exemplar portions of resulting patterns revealed that the former were more resistant to destruction. Thus, not only had the network produced the same differentiation between category and exemplar knowledge observed in patients, but the results indicated that this pattern of performance was due to the greater resilience of categorical information.

The familiarity/frequency account has also been used to explain category-specific naming deficits. It has been suggested that there are differences between living and non-living categories in terms of item familiarity and frequency and that this could account for the apparent specificity of naming deficits. To examine this, Funnell and Sheridan (1992) and Stewart, Parkin and Hunkin (1992) controlled for effects of familiarity/frequency in naming tasks administered to patients diagnosed with a category-specific naming deficit and found no evidence of differential performance in naming. It is clear from these studies that performance on language-related tasks is influenced by item familiarity/frequency. Though, whether familiarity/frequency accounts fully for the differentiation between exemplar and categorical knowledge or is simply one of several factors that influence the phenomenon has yet to be determined.

The fragmentary knowledge account

Patterson and Hodges (1995) and Hodges et al. (1995) acknowledge the importance of frequency effects, but argue that it represents another aspect of language function that requires its own explanation. In particular, familiarity/frequency models offer little in terms of an analysis of knowledge structure. If attribute knowledge is selectively affected because of its weakness relative to category knowledge, how is the structure of these memory representations altered in the course of the dementing process? Hodges and his colleagues (1995) address this issue without resorting to assumptions about hierarchical structures or selective vulnerability. Their fragmentary knowledge account is based on an earlier proposal by Rapp and Caramazza (1989, 1993) that a randomly degraded semantic representation will be able to support performance on tests of categorical or higher-level knowledge. Under this view, sufficient knowledge remains in fragmentary semantic representations to support generalizations but not specifics. For example, imagine that as a consequence of damage, the remaining properties of the concept "cat" consist of knowing that it has fur, legs, whiskers and is a mammal (see Figure 3.2). This residual information would be sufficient to identify a cat as an animal, but not to discriminate it from other animals with similar characteristics (e.g., dogs and rabbits). Thus, the differential performance on tests of category and attribute knowledge could result from the interaction between a randomly damaged knowledge base and normal retrieval mechanisms.

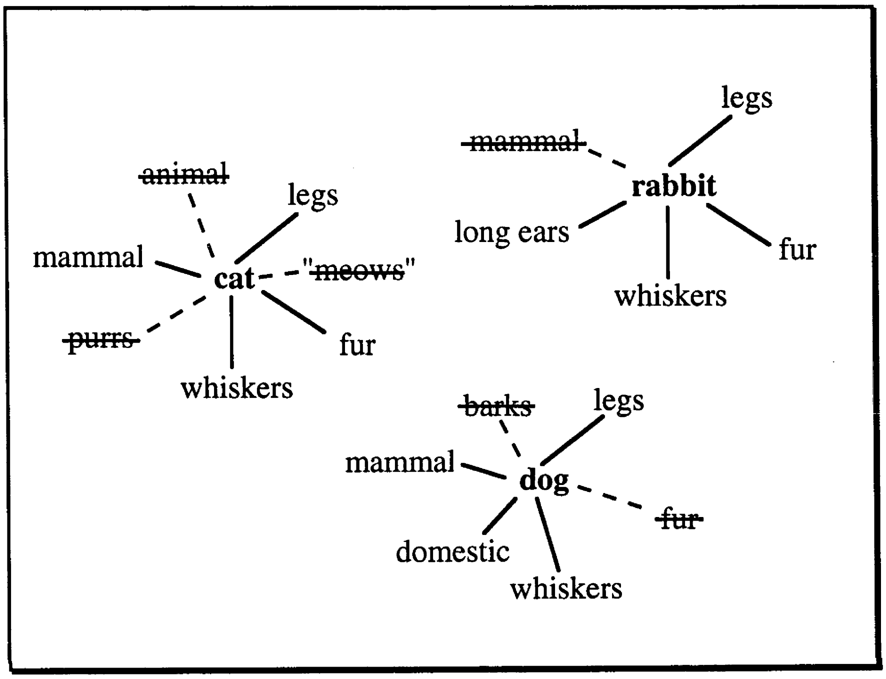

Figure 3.2 Illustration of the structure of degraded concepts according to a fragmentary knowledge account.

Summary

Since Warrington's (1975) original observations, we have gained some ground both in terms of establishing the existence of preserved memory for generalities in particular forms of dementia and the relevance of the phenomenon to theories of semantic memory organisation. However, there has been no discussion (apart from that offered by Haslam et al. (1997)) of the generalizability of the phenomenon to other clinical conditions where semantic knowledge is compromised. For instance, both remote and newly acquired general knowledge can be compromised as a consequence of the various pathologies that result in global amnesia. In fact, there is some evidence to suggest that the residual knowledge demonstrated by amnesic patients may reflect preservation of memory for generalities. This evidence will be examined in the next section.

3.2. Preservation of memory for generalities in amnesia

The evidence for preserved higher-level knowledge in amnesia consists mainly of studies in which the generalities phenomenon was not the principal focus of investigation. In these studies, differential memory performance was either an indirect consequence or a direct consequence of the testing procedures used. The former provide indirect evidence of the generalities phenomenon and the latter direct evidence. The second type of evidence to be considered comes from research in which memory for generalities in amnesia was central to the investigation. The single case study by Haslam et al. (1997) appears to be the only explicit investigation of the preserved memory for generalities phenomenon in amnesia. This study provided the basis for the present program of research and therefore will be considered in detail.

3.2.1. Research primarily concerned with other theoretical issues

Indirect evidence

Several studies provide indirect indications of preserved higher-level knowledge in amnesic patients. These studies focused on issues in the amnesia literature — first, the role of semantic and episodic memory in vocabulary acquisition (Verfaellie et al., 1995) and secondly, susceptibility to memory illusions (Cermak et al., 1973; Schacter, et al., 1996).

Verfaellie et al. (1995) conducted a series of experiments with an amnesic patient, SS, in which the primary aim was to identify the processes involved in vocabulary acquisition. In the first experiment they used explicit tests of recall and recognition to examine knowledge of words that had entered the language both before and after the onset of amnesia. Having found that knowledge of postmorbidly encountered words was more severely impaired, the researchers proceeded to examine the nature of the memory deficit. It was possible that impaired performance on the explicit tests reflected a deficit in accessing information about novel words. This question was examined in the second experiment using a semantic priming task. In this task novel words, unknown to SS, served as primes and lexical decisions were made to both related and unrelated targets. If the deficit in recall and recognition was due to a failure to acquire novel words (i.e., acquire novel representations) then lexical decision time for related and unrelated words should be equal. In fact, this is what occurred, which suggested that SS had no knowledge of the meanings of novel words. Although it was clear from these experiments that SS had no access to novel word meanings, it was possible that he had acquired some familiarity with them in terms of their lexical status. To examine this, a third experiment was conducted in which SS's ability to identify the lexical status of novel words and pseudowords (which were derived from the novel words) was examined. It was found that SS was very poor at discriminating real words from pseudowords compared to controls, again suggesting that he had acquired little if any knowledge about novel items.

While the findings from these experiments implied that SS had acquired no knowledge at all of postmorbidly encountered words, results of a fourth experiment provided evidence to the contrary. In this experiment a sentence verification task was used to measure novel word acquisition. It was considered that provision of context at test might facilitate performance. SS was asked to identify which of a pair of sentences used target, or novel, words appropriately. There were two types of sentence pairs. One type assessed knowledge of a word's general meaning: the incorrect sentence completely misused the target (e.g., "The warehouse was secured after all the *futons* had been latched"). The second type assessed knowledge of specific meaning: the incorrect sentence in this case preserved the word's general semantic meaning (e.g., "In her new apartment the tablecloth looked best on the *futon*"). Results indicated that SS had acquired sufficient knowledge about the meaning of novel words to differentiate sentences in terms of their general meaning only. Further analysis revealed that this result was due to SS's superior performance on compound words, which were items consisting of two meaningful (and pre-existing) words.

Based on these findings Verfaellie et al. (1995) concluded their patient was capable of acquiring novel information. This knowledge was evident for compound words only and was restricted to more generic information about word meaning. These researchers suggested that SS's superior performance with compound words was facilitated by the formation of novel connections during learning between pre-existing concepts in semantic memory. Non-compound words require the establishment of novel items in semantic memory, a function they attribute to episodic memory, in addition to the formation of connections. On this basis, the authors claimed that acquisition of category-based knowledge was restricted to items that have some form of pre-existing representation. The results of Verfaellie et al.'s final study can be seen as representing a case of preserved memory for generalities corresponding to the condition reported in dementia. That is, SS may have been accurate in discriminating on the basis of general and not specific meaning because he could only acquire partial, perhaps broad category-based, information about the target items.

Semantic confusions or errors provide one means of indirectly demonstrating preservation of knowledge in dementia. A similar approach has been used to investigate residual knowledge in amnesic patients. For instance, Cermak et al. (1973) examined the errors that Korsakoff patients made in the course of identifying item repetitions in a word list (see Experiment 4). While some words were actually repeated, others were either direct associates (i.e., table-chair), homonyms (i.e., meat-meet) or synonyms (i.e., robber-thief) of preceding items. Patients were asked to read through a list of words and indicate whether any of the items had been shown previously. They found that Korsakoff patients made more recognition errors than controls and that these comprised mainly homonym and associate errors. While these findings were seen as reflecting on patients' encoding preferences, they could also be interpreted as supportive of partial knowledge preservation in amnesia. That is, the findings suggest that patients must have formed some general memorial representation of items during study.

Schacter et al. (1996) investigated memory illusions in amnesic patients to determine their susceptibility to recall and recognize falsely associates of studied items. Patients were presented with a series of word lists which they were asked to remember. Each list contained words that were strongly related to a particular target item or lure. The lure itself was not actually presented. For example, if the non-presented target word was "sleep" then the words heard by participants might include: bed, rest, tired and dream. After the word list had been presented participants were asked either to recall as many items as they could remember or to perform some calculations. This was followed by presentation of the next list. This procedure was repeated until a total of eight lists had been presented. Recognition was examined several minutes after completion of the final recall or calculation task.

Although these researchers found that non-impaired controls were more prone to false recollection than amnesics, several observations indicated that patients had acquired at least partial knowledge of words presented during study. The first observation relates to the recall data. Here, Schacter et al. separated responses according to whether they were unrelated to the studied list, related to the list just studied or related to previously studied lists. On the basis of this breakdown it was found that controls produced significantly more critical lures (i.e., related to the list that was just studied) than amnesics indicating that the former group were more susceptible to false recollection. It could be argued though, that separation of related responses into just studied and previously studied lists is clearly biased against amnesic patients (particularly when all eight lists were presented in the same session). Such a discrimination may require access to more specific memory representations which are not available to these patients. This bias can be removed if related responses (from just studied and previously studied lists) are combined. To determine susceptibility to false recollection, "related" responses can be compared with "unrelated" responses. This comparison shows that the percentage of "related" relative to "unrelated" responses is approximately equal in amnesic patients and controls (78% versus 22% for amnesics and 81% versus 19% for controls, for related and unrelated responses respectively). Thus, results of this alternative analysis suggest that both groups tended to falsely recall words that were semantically-related to studied items.

Schacter et al.'s recognition data provide further evidence of partial knowledge preservation in patients. Again, as expected, recognition accuracy was significantly lower in patients. Amnesics also tended to recognize fewer critical lures than controls. However, they recognized significantly more critical lures than distractors as "old". This result indicates that patients were influenced by critical (or just studied) items to some degree. Together, the findings from recall and recognition data indicate that patients acquired and retained partial knowledge of studied materials sufficient to influence their memory performance on certain tasks. Schacter et al. (1996) concluded that amnesic patients relied more heavily on *general* semantic associations formed at study due to the absence of *specific* representations. In order to account for the greater frequency of non-critical responses that patients tended to make, the authors raised the possibility that the semantic trace itself was poorly organized and degraded.

The finding common to all these studies is that amnesic patients exhibited partial knowledge. This indicates that they formed some memorial representation of materials they encountered at study. More important though, is the fact that this partial knowledge was general in nature. Irrespective of whether semantic confusions or word meaning were examined, patients were only successful in making judgements that required knowledge of more general categorical (or semantic) relationships. In other words, the patients in these studies appear to have shown preservation of higher-level knowledge in the context of impaired item-specific knowledge.

Direct evidence

While some of the relevant studies revealed higher-level knowledge in amnesia only incidentally, there are several studies in which this has been the primary focus. These have involved patients with anterograde amnesia as well as retrograde amnesia. In the case of retrograde amnesia, researchers have examined knowledge at several levels of detail including both general and specific (Hodges & McCarthy, 1993; McCarthy & Warrington, 1992). Results indicate that remote memory is not completely lost in these patients and that the pattern of preservation appears to be characterized by loss of item-specific information.

In the case of anterograde amnesia, researchers have been motivated by a wish to understand the processes that support acquisition of categorical knowledge. Two types of study have yielded evidence indicating preservation of memory for generalities. The first involves a series of experiments which focused largely on artificial grammar learning and categorization of dot patterns (Knowlton, Mangels & Squire, 1996; Knowlton, Ramus & Squire, 1992; Knowlton & Squire, 1993, 1994, 1996; Kolodny, 1994; Squire & Knowlton, 1995), and the second relates to a study by Verfaellie and Cermak (1994) which addressed the relative components of generic and episodic components of recall in list learning. It appears that general-level knowledge was preserved and more specific lower-level knowledge was impaired in these studies. However, this inference was not drawn by the researchers. Instead, the authors presented interpretations based on dissociations between semantic and episodic, or implicit and explicit, memory.

Retrograde amnesia

The pattern of residual knowledge reported in two amnesic patients appears consistent with preservation of memory for generalities. Both patients presented with memory loss for knowledge acquired prior to the onset of amnesia, including that concerning famous people and events. However, it was clear that all of their knowledge from the past was not lost. One case, RFR, became globally amnesic following a bout of herpes simplex encephalitis (McCarthy & Warrington, 1992) and a second patient, PS, developed retrograde amnesia as a consequence of thalamic infarction (Hodges & McCarthy, 1993). In both cases the period of retrograde amnesia was quite extensive and reported to be at least 20 years.

McCarthy and Warrington (1992) used several different tests to assess residual remote knowledge in RFR. When faces were used as the stimuli, RFR was only accurate in judging familiarity. He could select the famous face contained in a set of unknown faces but could only provide minimal information about several people when asked to define a set of faces. However, the information sourced from names was richer in detail. Not only was RFR able to recognize famous names as familiar, he could also provide the superordinate professional role (i.e., actor or politician) for the majority of names presented. Thus, while RFR's responses were limited to familiarity judgements for faces, they extended to the superordinate professional role with names. In both modalities though, the knowledge retained can be considered relatively high level.

Hodges and McCarthy's (1993) patient, PS, was also accurate in making fame judgements. In this case this was irrespective of whether the stimuli presented were names or faces. Furthermore, he was able to provide additional descriptive information when asked to identify famous faces and names. However, he performed best when providing superordinate category information.

Although PS was able to provide detailed semantic information about some people on the famous faces task (presumably including more detailed professional information — such as type of politician), identification of the superordinate professional role was clearly superior (i.e., 92% and 68% accuracy for superordinate role and detailed semantic information respectively). This pattern is again consistent with superior memory for generalities.

Results obtained from these two cases of retrograde amnesia were interpreted by the researchers in terms of particular patterns of dissociation between postulated memory functions. In the case of RFR, McCarthy and Warrington (1992) focused on the dissociation between factual knowledge about a person and knowledge for event-related information. They proposed that RFR's knowledge of the former was preserved and the latter was impaired. The authors used this dissociation to support their argument that person-specific attributes were often embedded within particular events. For example, one's ability to differentiate between two previous Australian prime ministers (e.g., Gough Whitlam and Bob Hawke) from the same political party may be facilitated by the involvement of one of them in a controversial event (the dismissal of Gough Whitlam). Accordingly, if memory of events is lost, then ability to discriminate between people who share many common attributes (e.g., both labour politicians and leaders of the party) will be compromised.

In contrast, the results for PS (Hodges & McCarthy, 1993) were interpreted as due to a difference in the preservation of semantic and autobiographical knowledge, with the former preserved and the latter impaired. Thus, although there is some suggestion that these patients (especially RFR) had difficulty accessing specific details about people, an explanation of the phenomenon in these more general terms was not considered.

<u>Anterograde amnesia</u>

The majority of studies directly investigating higher-level knowledge in amnesics have involved anterograde amnesia. These studies have concentrated on patients' capacity to acquire categorical information. The main advantage in exploring new learning capacity is that no estimates of pre-existing knowledge are required. In the case of retrograde amnesia, researchers assume that patients have knowledge about famous people prior to the onset of their amnesia. However, the limits of this pre-existing knowledge are rarely known. Such assumptions are not required in studies conducted with anterograde amnesics, where researchers need only ensure that the studied materials are novel.

Knowlton, Squire and colleagues have attempted to identify the processes involved in category-based learning (Knowlton, et al., 1996; Knowlton, et al., 1992; Knowlton & Squire, 1993, 1994, 1996; Kolodny, 1994; Squire & Knowlton, 1995). In particular, they have tried to determine whether category learning is supported by implicit or explicit memory. Much of this research has focused on artificial grammar learning (Knowlton, Mangels & Squire, 1996; Knowlton, Ramus & Squire, 1992; Knowlton & Squire, 1994, 1996), though several studies have also investigated categorization of dot patterns (Knowlton & Squire, 1993; Squire & Knowlton, 1995) and paintings (Kolodny, 1994). In artificial grammar learning, patients are shown a series of letter strings which conform to a system of rules. Knowledge for these items is tested after several minutes using classification and recognition tests. In the classification test patients categorize novel strings as either grammatical or non-grammatical on the basis of "gut feeling". In the recognition test patients identify the specific items used in training. The findings from all these studies are consistent — patients perform well on classification tests but poorly on recognition tests.

This differentiation between classification and recognition has been used by the researchers to support the notion that categorical knowledge was acquired implicitly by these amnesic patients. They argue that accurate categorization does not require conscious knowledge of grammatical rules. However, others have suggested that classification may be supported by the residual resources contained within a partially damaged and inefficient explicit memory system (e.g., Perruchet & Pacteau, 1990). Knowlton and colleagues (Knowlton et al. 1992; Squire & Knowlton, 1995) have argued against this proposal. Their amnesic patients were as accurate as controls in making classification judgements and it is argued that this is inconsistent with the notion of explicit contamination — if explicit memory were required for these judgements then control performance should have been superior to that of amnesic patients. Furthermore, comparison of recognition and classification results did not support the suggestion of explicit contamination. Not only was recognition performance in amnesic patients at chance level, it was also significantly worse than that on classification. Given the difference in performance on these tests, it is difficult to argue that classification and recognition rely on the same explicit memory processes.

Another issue concerns the information used for grammaticality judgements. In the course of learning, do patients acquire abstract knowledge about grammatical rules or do they use more concrete information specific to trained items? Knowlton and Squire (1996, Experiment 3) investigated the generalizability of grammatical learning. They examined transfer of grammatical knowledge to letter-strings not used in training. A lack of generalization would indicate reliance on concrete or exemplar-based information, while transfer of knowledge would indicate reliance on more abstract information about grammatical rules. It was found that amnesic patients and controls could transfer knowledge, but that in both groups classification was significantly improved when the same letters were used in training and test. Based on these and other related findings, Knowlton and Squire (1996) conclude that both abstract and exemplar-based knowledge are used in making grammaticality judgements.

The studies by Knowlton and her colleagues imply that a kind of category-based learning is preserved in amnesia. However, results of another study suggest that this is only true for certain types of tasks. Kolodny (1994) found that a group of amnesic patients could learn to classify dot patterns but could not categorize Italian Renaissance paintings. He suggested that this differentiation in performance reflected the richer content of paintings making categorization of such materials more complex. The greater involvement of explicit memory processes in the categorization of paintings was also considered to be a possible factor underpinning patients' poor performance on such tasks.

Pickering (1997) has expanded on Kolodny's conclusions by analyzing the differences between various categorization tasks and relating this to the possible brain structures involved in these tasks. While Kolodny provided no basis (apart from complexity) for discriminating between classification tasks, Pickering's analysis is based on the degree to which reference to exemplar representations was required in such tasks. He argued that some classification tasks required individuals to reference exemplar representations and that painting categorization was an example of this. In contrast, classification of dot patterns, and presumably artificial grammar learning, requires access to prototype representations formed by averaging across specific exemplars. Pickering postulated that hippocampal structures are important in the formation of exemplar representations and that the mammillo-thalamic pathway is involved in associating these representations with responses (e.g., category naming). This enables predictions about amnesic categorization performance based on the type of task employed and the particular brain structures compromised. For instance, diencephalic amnesics should be able to develop exemplar representations and patients with hippocampal damage should not. However, lesion-based predictions would be limited by the degree to which damaged structures can be specified precisely. While neuroimaging techniques are certainly improving, there remain many cases where the exact location of lesions is unknown.

A different approach to higher-level learning in amnesia was taken by Verfaellie and Cermak (1994). As in the case of Knowlton and her colleagues, these researchers were interested in the nature of general knowledge acquisition in amnesic patients. However, the focus in Verfaellie and Cermak's study was on the implications of generic learning for semantic and episodic memory. In particular, was higher-level knowledge in anterograde amnesics supported by a preserved generic (i.e., semantic) system or was it supported by a partially operational episodic memory system? To examine this they adopted a task in which context-free (or generic) and episodic components could be differentiated. This involved presenting a word list to patients. Some items were presented once and others twice. Words were presented in unique colours to determine whether an item's individual presentation could be remembered. It was reasoned that if memory for repeated items was based on item-specific knowledge (or the item's individual presentation), then no difference should be found in item and colour recall.

Both amnesic patients and controls were more accurate in recalling repeated words. However, more importantly, there was a difference between item and colour recall. While amnesic patients recalled a greater-than-expected number of repeated words, the opposite pattern was observed on colour recall. Since recall of colours for repeated items was worse than that for items presented only once, it was concluded that the superior performance observed for repeated items did not reflect any memory for particular presentations of words. Rather, it reflected some more general knowledge about the items. One possible interpretation of this is that semantic, or generic, knowledge is acquired independently of episodic memory. This view is in opposition to that of researchers who believe that semantic knowledge emerges from episodic experience (e.g., Kinsbourne & Wood, 1982). In addition though, Verfaellie and Cermak's patients performed significantly worse than controls on the measure of generic memory (i.e., recall of repeated items). Thus, there was evidence of an additional deficit of generic or semantic memory that could not be explained by damage to episodic memory.

Summary of direct and indirect evidence

Both direct and indirect assessments of higher-level learning in amnesic patients have been directed towards testing theories of amnesia. They are of interest in the present context because, irrespective of whether they involved direct or indirect examination, or remote or newly acquired knowledge, they found a differentiation in performance on tests of generic and item-specific knowledge. This pattern of performance is similar to that reported in particular forms of dementia and raises the possibility that the generalities phenomenon occurs outside of this particular condition. While there are clear differences between patients with amnesia and dementia in terms of the structural locus of the deficit(s) and their clinical presentation, it is possible that the mechanism responsible for the differences between exemplar and higher-level knowledge observed in both groups is the same. This link between the two conditions was first highlighted by Haslam et al. (1997). This study will be discussed in greater detail in the next section.

3.2.2 Research primarily concerned with the generalities phenomenon

Preserved category learning in amnesia: The case of MK.

In contrast to other research, the study previously published by the author and her colleagues (Haslam et al., 1997) explicitly attempted to relate the generalities phenomenon to amnesia. In this study capacity for new learning in an amnesic patient was determined by performance on tests of high- and low-level categorization. The findings suggest a possible link between amnesic patients and dementia sufferers in terms of their apparent preservation of memory for generalities.

The primary aim of Haslam et al.'s (1997) study was to determine whether an amnesic patient (MK) could acquire any knowledge at all of novel materials, and if so, to clarify the nature of that learning. The patient was asked to study novel items from two familiar categories — animals and fruits/vegetables. There were 14 items in each category, all of which were identified by MK and his wife as non-words in a lexical decision task. MK's task was to learn picture-name associations. The study phase took place over a period of four weeks. Each day, MK received two training sessions during which all target items were presented individually. For every item, its picture and name were displayed together and MK was instructed to remember the associations (via free-association). Each study session lasted 30 minutes at most. At the end of each week MK's knowledge for these associations was tested using recall and matching-to-sample tests. The recall test involved presenting studied pictures only that MK was required to name. In the matching-to-sample test MK was presented with individual pictures (from one category and then the other) and a list of names, and he was asked to choose the correct name for the pictured item. The list of names contained 14 studied names and 14 non-studied (or distractor) names from the same category. The non-studied names were also items that MK identified as non-words in a lexical decision task.

Over the four week period no evidence of learning was found on these traditional tests of memory (see Table 3.1). MK could not recall the name of *any* item from either the animal or fruit/vegetable categories. In the matching-to-sample test, four items at most were correctly identified on any individual session and there was no consistency in item-responding from week to week. However, since these memory tests were explicit in nature, and amnesic patients perform poorly on such tests, it was not surprising that no evidence of learning was found. To determine whether MK had acquired any information at all about items, an alternative forced-choice method was used to access knowledge. No further study sessions were administered after the completion of the four week learning phase.

Session	Animals		Fruits/Vegetables	
	Recall	Match-to-sample	Recall	Match-to-sample
1	0	3	0	1
2	0	1	0	4
3	0	0	0	2
4	0	0	0	4

Table 3.1 Recall and matching-to-sample test results (No. correct identifications/14) during the initial study phase (from Haslam et al., 1997).

Two sets of forced-choice tasks were employed. In the first set two tests were administered in which only the names of stimuli were presented. One consisted a two-alternative forced-choice test in which MK was presented with two studied names, one from each category (animals and fruits/vegetables), and asked to select the animal from the pair. MK was accurate in identifying animals correctly (scoring 13/14), but claimed that he was only guessing. A yes/no recognition test was also administered several months after completion of the study phase. In this test MK was presented, first, with studied items and then with non-studied items (i.e., distractor items from the word list used in the matching-to-sample test) and in each case he was asked to determine whether the name belonged to an animal. He was capable of identifying the animals which had been in both the studied and non-studied sets. Thus, his performance on both tests indicated he had acquired some novel information about each item although he could not name them.

Additional evidence of a differentiation in performance between categorical and exemplar knowledge was provided by a second set of forced-choice tasks. Three tests were administered all of which involved presentation of pictures together with name pairs. The first test, a *between-category discrimination test*, involved presentation of a picture and the name of an item from each category. MK selected the correct name for the picture with a high degree of accuracy (22/28 correct). A *within-category discrimination test* was then administered in which the name-pair comprised items from the same category (i.e., two animal names or two fruit/vegetable names). On this test MK's ability to correctly assign a name to the picture was at chance (14/28 correct). A final *between-category (with foils) discrimination test* was administered in which the name-pair consisted of an item from each category, but with neither name correct. MK showed no hesitation in making a selection though, as in the previous tests, claimed he was guessing. Although all of his responses were necessarily incorrect, there was a significant tendency to select names on the basis of the semantic category cued by the picture (22/28 were from the correct category).

Several conclusions can be drawn from these tests. First, MK acquired sufficient knowledge about studied materials to discriminate between items on the basis of their higher-level semantic category (indicated by the accuracy with which MK discriminated animal from non-animal names). Secondly, categorical knowledge was better preserved than item-specific knowledge. MK's judgements were accurate when items in the name-pair were from different categories, but he was no better than chance when items were from the same categorical group. More importantly, between-category judgements were significantly better than within-category judgements. Further evidence of impaired exemplar knowledge relative to category knowledge was found in the discrimination test with foils. Had MK refused to select one of the names offered, then this would indicate preservation of knowledge beyond the category level. However, he chose items on a categorical basis freely and claimed that he was only guessing. Based on these findings, Haslam et al. (1997) concluded that the pattern of memory performance produced by MK was characterized by preservation of higher-level category knowledge and impairment of exemplar knowledge.

This pattern of performance, labelled as *preserved memory for generalities*, implies similarities between patients with amnesia and dementia. Given these similarities, it is worth considering MK's results in terms of theoretical analyses of the generalities phenomenon in the dementia literature. Of the two most feasible theories of "generalities" in dementia, the fragmentary knowledge account offered by Hodges and his colleagues (1995) fares best in explaining MK's performance. It is possible that MK acquired only fragments of the information he studied and this could explain the high degree of accuracy in his performance on all tests of categorical discrimination. In the course of learning to associate a picture with a name, he may only have been capable of remembering some fragments of the information provided in the picture (e.g., that the item has a head, moves and has legs). These fragments would have been sufficient to identify the name as that of an animal, for example, through a process of deduction — if the item has a head, legs and moves it is probably an animal. Thus, in the forced choice tests when matching one of two names from different categories to a picture, MK would simply refer to the fragmentary knowledge he had of the names to identify the category of item the picture cued. This knowledge would be sufficient to discriminate animals from fruits/vegetables. However, these fragments of knowledge for items from the same category may be quite similar to one another and thus would not support within-category discriminations.

A fragmentary knowledge account can also explain MK's performance in categorization of non-studied/distractor names from the matching-to-sample test. MK was accurate in identifying the animal from a set of distractor names (i.e., in the yes/no recognition test) and this result was somewhat unexpected. However, it is possible that distractor animal names, for example, acquired animal attributes through their association with studied animal names. This information would be sufficient to discriminate animal distractors from fruit/vegetable distractors. Thus, not only does this fragmentary knowledge account explain the degradation of semantic memory observed in dementia, it also explains the acquisition of partial semantic knowledge observed in MK.

Funnell's familiarity/frequency account, on the other hand, cannot explain the acquisition of higher-level knowledge in MK. His success in category discrimination could only be supported through the association of some categorical properties with names. For example, to distinguish between "vicuna" and "aubergine" MK would have to know that the first name had some animal properties and the second name some fruit/vegetable properties. These were presumably acquired in the course of presenting picture-name associations during study. In this experiment, a familiarity/frequency account predicts superior performance on the basis of greater exposure to particular items. However, because the names themselves represent an infrequently encountered attribute of the item in question (i.e., "vicuna" was only presented once even though examples of animals appeared 14 times), preservation of categorical knowledge in this study is inconsistent with Funnell's account.

Haslam et al.'s results suggest that preservation of memory for generalities may not be confined to dementia. The link between these two patient groups is based largely on results of this one study (although, as noted earlier, this conclusion is supported indirectly by a range of other studies). Additional evidence of this phenomenon in amnesics is required to establish a generalities-type account as an alternative characterization of deficient memory processes in these patients. Furthermore, the majority of studies that provide support for the generalities phenomenon in amnesia have examined acquisition of new information. In the case of dementia, preservation of memory for generalities has been demonstrated in the context of knowledge loss. This issue concerning damage to pre-existing knowledge should also be investigated in patients with the retrograde form of amnesia. Earlier in this chapter, evidence of partial knowledge preservation in retrograde amnesia was presented (i.e., Hodges & McCarthy, 1993; McCarthy & Warrington, 1992) and the pattern of memory preservation appeared consistent with a generalities account. As in the case of anterograde amnesia though, additional evidence of the generalities phenomenon is required in retrograde amnesia. This is provided by the series of experiments reported in this thesis. These studies attempt not only to clarify the reliability of the generalities phenomenon but to tease out theoretical issues related to its explanation.

3.3. Overview

The relevance of the generalities phenomenon to semantic memory structure has been demonstrated most clearly in patients suffering from dementia. The pattern of semantic memory deterioration observed in these patients has served to highlight various aspects of conceptual organisation and representation, in particular the composition of individual concepts in terms of their attributional structure and the relationship between concepts. Several theoretical accounts have been developed to address these issues, though there is no general agreement at this stage about whether familiarity/frequency or fragmentary knowledge accounts provide the best analysis of conceptual structure.

There is some indication of preserved memory for generalities in the amnesia literature. However, only limited evidence supports differential performance on tests of exemplar and higher-level knowledge in amnesia and much of this is based on results of studies in which other issues were examined. In the dementia literature, preservation of memory for generalities has been demonstrated in the context of categorization behaviour involving discrimination of high- and low-level information. The majority of relevant studies reported in the amnesia literature have used quite different methodologies and thus, it could be argued that links between these studies and those from the dementia literature are tenuous. Only one study, by Haslam et al. (1997), has looked explicitly at categorization behaviour in the course of examining memory performance in amnesia. Additional evidence is required if the similarities between these conditions are to be strengthened. This thesis extends the findings of Haslam et al. by providing additional evidence of the phenomenon in amnesia and exploring its properties. In particular, the use of direct and indirect tests in accessing higher-level knowledge is investigated. Preservation of memory for generalities is considered in relation to retrograde amnesia as well as anterograde amnesia. The influence of study context is also explored. Finally, an examination of the relevance of the generalities phenomenon to normal memory function is provided.

Chapter 4

Overview of empirical chapters

It is clear that amnesic patients have some residual memory capacity. The question is, what information do these patients acquire or retain? This thesis addresses this question by investigating the nature of *partial knowledge* preservation in these patients. Specifically, do amnesic patients acquire or retain partial knowledge, and if so, is this knowledge more general (i.e., higher-level) in nature?

In the following chapters a series of experiments are presented in which preservation of memory for generalities is investigated in amnesic patients. The aim of these studies was, first, to provide additional evidence of the generalities phenomenon in amnesia and, second, to explore its properties. The latter involved examination of the role of direct and indirect testing, the influence of study context and the relevance of the phenomenon to both anterograde and retrograde amnesia. The empirical work in this thesis is based largely on results of studies conducted with three amnesic patients who are described in Chapter 5.

Results of three experiments in which memory for novel face-occupation associations was examined are presented in Chapter 6. In the first of these experiments patients acquired sufficient knowledge of face-occupation associations to discriminate faces according to their general class (i.e., whether they were educators or tradespeople) but not on the basis of the specific professions they had studied (i.e., teachers, lecturers, electricians and plumbers). Classification at a lower occupational level was introduced in the second study and results showed that for at least one patient a modification in study context facilitated access to knowledge (i.e., at the level of teacher/lecturer) that had not been available in the previous study. Finally, the contribution to these results of the mode of testing higher-level knowledge was investigated. It was possible that results in the first two experiments were due to differences in response mode between tests of high- and low-level knowledge. Knowledge at the high-level was examined indirectly in terms of patterns of response confusion, while that at the low-level was examined directly. Findings indicated that indirect tests were indeed more effective than direct tests in accessing higher-level knowledge. Thus, these first three experiments provide additional evidence that the generalities phenomenon might be found in amnesia as well as dementia. It is also shown that what constitutes a "generality" may be dependent on study context and that response mode has an important influence on the memory performance of amnesic patients.

In this first series of experiments there was no evidence of higher-level knowledge in tests that were of a direct nature. Yet this did not rule out the possibility that such knowledge might be demonstrated provided the information tapped is sufficiently general. This question was investigated two studies (Experiments 4 and 5) described in Chapter 7. Memory for face-name-occupation associations was examined in these experiments and up to five levels of knowledge, ranging from the very general to the very specific, was tested directly. Results showed that patients could access some knowledge directly and that this tended to be at the most general levels examined. However, the amount of information accessible under direct questioning differed between patients.

Evidence of preserved memory for generalities in retrograde amnesia was investigated in three experiments which are reported in Chapter 8 using the same techniques as those employed in Chapters 6 and 7. In the first two studies, knowledge in the autobiographical domain was examined. The first of these investigated autobiographical knowledge directly using the procedure employed in Experiments 4 and 5. A pattern of preserved memory for higher-level information and impaired memory for lower-level detail was found, but only with face cues. The patient was capable of accessing all information requested with name cues. This suggested that the amount of semantic information accessible from faces and names differed — a result that has important implications for models of face recognition. Having identified the level of generality at which memory broke down on direct questioning in the autobiographical study (i.e., the level requiring discrimination between family and friends), a second experiment was conducted to determine whether knowledge at this level could be accessed using indirect methods of testing. The approach was similar to that employed in the studies reported in Chapter 6. Indirect examination of higher-level knowledge was achieved by asking the patient to discriminate between types of family member (i.e., discriminating people from her side and her husband's side of the family) and types of friend (i.e., discriminating old friends from new friends). It was found that under these conditions the patient could differentiate family members from friends, but not between types of family and types of friend.

The final study reported in Chapter 8 investigated remote memory for generalities in the domain of public knowledge. This experiment focused exclusively on the amount of information that patients could provide in response to direct questions about famous people (i.e., actors and sportspeople). Evidence of memory impairment was found in the one patient who suffered from retrograde amnesia. This patient was only capable of responding accurately to questions at the most general knowledge levels examined. In addition, the patient accessed more semantic information from name cues and this confirms the previous observation that cue type had an influence on the availability of knowledge. Results of these three studies indicate that preservation of memory for generalities also occurs in retrograde amnesia.

The fact that patients with amnesia and dementia remember higher-level information better than lower-level information is not necessarily surprising, since a similar finding might be predicted in non-clinical populations. It could be argued that many of the confusions we make on a daily basis reflect better memory for generalities. For example, when two names are confused there is tendency for them to be related in some way (e.g., you may confuse the name of a teacher with the name of lecturer). The relevance of the generalities phenomenon to normal memory is investigated in Chapter 9. The experiment reported in this final chapter adapted the first three studies (in Chapter 6) in a non-impaired sample. This sample showed a pattern of superior memory for higher-level information similar to the amnesic patients, indicating that the generalities phenomenon is not confined to cases of pathological memory. However, unlike the amnesics, normal subjects were not influenced by manipulations in testing. They performed equally well in direct and indirect tests of higher-level knowledge.

Several conclusions can be drawn from these studies. Most importantly, they demonstrate that the generalities phenomenon previously reported in dementia can occur in other clinical conditions and, indeed, in normal memory. This has implications for understanding of the memory disturbance in both forms of amnesia and memory function in general. There were some other findings whose implications are either less clear (e.g., the role of context and the demonstration of preserved memory for generalities at lower levels of categorization) or not directly relevant to the generalities phenomenon (e.g., the differentiation in performance with faces and names). These issues and their theoretical implications are considered in the concluding chapters of this thesis.

Chapter 5

Investigating memory for generalities in amnesia: Case histories

Preservation of memory for generalities in amnesia was investigated with the assistance of three patients who are identified in the following empirical chapters as IP, GS and TG. These patients were selected on the basis of two criteria. First, a diagnosis of global amnesia was required. Two patients, IP and GS, suffered from anterograde amnesia. TG, suffered from both retrograde and anterograde amnesia. A second requirement was that knowledge about concepts (i.e., an aspect of semantic memory) was preserved. This was particularly important given that knowledge about certain occupations and the relationships between these occupations was required in the majority of studies conducted. Only common occupations were included in the studies and all patients indicated that they had a good understanding of them.

A battery of tests was administered to determine whether patients met these criteria. The test battery examined a number of cognitive functions. These comprised: general intelligence, memory, visual perception and executive or frontal lobe function. Results are summarised in Tables 5.1 to 5.3 and impairment is indicated by an asterisk marked alongside the relevant test scores (with the exception of category fluency for which appropriate norms were not available). An indication of current intellectual status was provided by the Wechsler Adult Intelligence Scale - Revised (WAIS-R; Wechsler, 1981). Comprehension was examined objectively using a modified version of the token test (Spreen & Benton, 1969).

Three areas of memory function were examined. Remote memory was examined using the Autobiographical Memory Interview (AMI; Kopelman, Wilson & Baddeley, 1989, 1990) as well as a modified version of the Crovitz-Schiffman technique which involves presentation of high frequency nouns (in this case 10 nouns) to evoke past memories (Zola-Morgan, Cohen & Squire, 1983). Although there are other tests of remote memory function, examining knowledge about famous people and famous events, these were deemed to be inappropriate for an Australian population given their European bias. Capacity for new learning was examined using the Wechsler Memory Scale - Revised (WMS-R; Wechsler, 1987), the Rey Auditory Verbal Learning Test (RAVLT; Lezak, 1995; Taylor, 1959) and the Rey-Osterrieth Figure (Corwin & Bylsma, 1993; Spreen & Strauss, 1991). The WMS-R also provided an indication of attentional capacity. Semantic memory was examined using tests of category fluency (Hodges, et al., 1995), letter fluency (i.e., Controlled Oral Word Association Test; Benton & Hamsher, 1976) and picture naming (Test 14, Birmingham Object Recognition Battery; Riddoch & Humphreys, 1993). The category fluency test was used to determine whether patients' knowledge for living and non-living concepts differed. This was included because one patient suffered from herpes simplex encephalitis — a condition in which category specific naming deficits are common (Snowden, Griffiths & Neary, 1994). In addition, a number of subtests from the WAIS-R are relevant to semantic memory function. Information, vocabulary, comprehension and similarities are particularly important as they provide an indication of an individual's general factual and word knowledge, both of which are believed to be contained in semantic memory. Other subtests, such as picture completion and picture arrangement provide an indirect measure of conceptual knowledge as performance on these tests will be hindered by any impairment to knowledge of objects and action sequences.

Two remaining functions were examined as impairment to either of these could have impacted on interpretation of patient performance in the series of studies presented in this thesis. Visual perception was examined, given that faces were used to cue memory in the majority of studies. To examine this function Benton's Facial Recognition Test (Benton, Hamsher, Varney & Spreen, 1983), Benton's Line Orientation Test (Benton, Varney & Hamsher, 1978) and the form discrimination component of Benton's Visual Retention Test (BVRT; Benton et al., 1983) were administered. Frontal lobe functions were evaluated since executive abilities, such as deficits in organisational capacity, may impact on memory performance (Lezak, 1995). Executive function was examined using the Rey-Osterrieth Figure, the Trailmaking Test (A and B; Davies, 1968), the Wisconsin Card Sorting Test (Heaton, 1981) as well as relevant subtests from the WAIS-R (i.e., block design, similarities and mental arithmetic).

5.1 Case IP

IP was 16 years of age when he became amnesic as a result of an intracerebral haemorrhage which he suffered in March 1995. Initial cranial CT scans pointed to the presence of haemorrhage involving the left caudate nucleus and ventricular system and the presence of an aneurysm at the bifurcation of the left internal carotid artery. A ventricular drain was inserted on the day of admission and the aneurysm was clipped on the following day. Several weeks after admission, ventricular enlargement was noted on repeat cranial CT scanning and this resulted in the insertion of a ventriculo-peritoneal shunt. A cranial MRI, performed in May 1995, revealed the recent insult involving the caudate nucleus and the presence of a shunt passing through the frontal horn of the lateral ventricle with the tip in the supramedial thalamus. Subsequent scanning (perfusion brain study with tomography) revealed cortical perfusion in the left hemisphere involving the prefrontal and mesial temporal regions, believed to be related to the recent vascular episode.

As he recovered from this insult significant, problems with his memory were apparent. In particular, IP was extremely forgetful, had great difficulty remembering recent events and appeared unable to acquire new information. As part of the investigations into his memory disturbance he was referred for neuropsychological assessment. These assessments were conducted in May and September 1995. Both examinations revealed a profound and global disturbance to memory with relative preservation of other cognitive functions. His profile had not changed over the course of these assessments, and it was no different from that revealed on the assessment conducted as part of the selection criteria for involvement in this study. The latter assessment was conducted in March 1996 and these results are discussed in detail below.

At the time IP was assessed for his suitability for the research program he was 17 years of age and had returned to school. He had adjusted reasonably well to his return to school as he was familiar with many of the teachers and students. However, he could not continue with the same classes given the severity of his memory problems. IP was aware of his memory problems and changes in his course of study but did not appear to be overly concerned by them.

Table 5.1 shows results of IP's assessment. On examination he was oriented for person and place, but not for time. There was no evidence of any language difficulties with respect to either comprehension or expression. Performance on a test of general intellectual function revealed consistent ability in verbal and performance domains and his overall intelligence quotient placed him in the "superior" range (performance was at the 95th percentile). However, performance on one subtest, measuring psychomotor speed, was inconsistent with this profile and the result obtained represented a moderate to severe reduction in ability (37th percentile). IP performed well on tests of planning/organisation, problem solving, abstract thinking and mental flexibility — all believed to be indicators of the integrity of frontal lobe functions (Lezak, 1995). Performance on tests of visual perception was largely intact with the exception of a moderate impairment on the face recognition test. In fact, this reflected a problem in matching degraded faces only (i.e., faces darkened to

General Intellectual Function:

WAIS-R:	Information	14	Picture Completion	13
	Digit Span	13	Picture Arrangement	14
	Vocabulary	11	Block Design	14
	Arithmetic	18	Object Assembly	--
	Comprehension	13	Digit Symbol	9*
	Similarities	13		
			Verbal IQ:	122
			Performance IQ:	124
			Full Scale IQ:	125

Anterograde Memory:

WMS-R:	Verbal Memory Index	62*
	Visual Memory Index	80*
	General Memory Index	58*
	Attention/Concentration Index	115
	Delayed Recall Index	<50*
RAVLT:	Trials 1 - 5 (/15)	5, 7, 5, 6, 8*
	Recall after interference	4/15*
	30 min. recall	0/15*
	30 min. recognition	5(+3)/15*
Rey Figure:	Copy	36
	3 min. delay	10*
	30 min. delay	9*

Autobiographical Remote Memory:

AMI:	Personal -	Childhood	21	Autobiog -	Childhood	8
		Early Adult	--		Early Adult	--
		Recent Life	19		Recent Life	4*

Modified Crovitz Technique (10 cue words)		26/30
Semantic Memory:		
Letter Fluency (FAS)		23*
Category Fluency:	Total animate	43
	Total inanimate	39
Picture Naming (BORB)		75/76
Comprehension:		
Token Test		163/163
Visual perception:		
Benton's Facial Recognition (long conversion)		37/54*
Benton's Judgement Line Orientation (total)		29/30
BVRT: form discrimination		32/32
Executive Functions (additional tests):		
Trailmaking Test:	A: 21"	B: 45"
Wisconsin Card Sorting Test:	6/6 sorts in 89 trials, .06% perseverative responses	

Table 5.1 IP's neuropsychological test profile (Note: * = impairment)

obscure much of the face). IP experienced no difficulty at all in matching non-degraded faces in this test and, in addition, was able to match faces used in the empirical section of this thesis with ease. On the whole, semantic memory function was preserved. Picture naming was normal as was his performance on WAIS-R subtests that are indicative of semantic memory function (e.g., vocabulary, comprehension, information). A test of category fluency revealed no difference in his knowledge of animate and inanimate concepts. However, a severe reduction in letter fluency was found (4th percentile) and, on its own, this may reflect a greater problem with selective generation of words than with semantic memory per se.

There was no evidence of impairment on tests of autobiographical remote memory. IP recalled very detailed memories in response to cue words and recalled both semantic and autobiographical events from his childhood with ease. Exploration of memories from early adulthood were inappropriate in this case given that IP was 17 years of age when the test was administered. As expected, recall of recent autobiographical memories was impaired. However, recall of recent personal semantic memories was within acceptable limits and this is generally inconsistent with an amnesic profile. This was mainly due to the accuracy of responses to questions pertaining to his present institution (i.e., part 7 of the AMI), which in this case was his school. He had attended the school for the past 5 years and so responses to questions relating to this institution may have been generated from past knowledge.

In contrast, performance on all tests of new learning was profoundly reduced. IP's ability to learn new information was very poor as was his capacity to retain this material over time (e.g., see RAVLT trials 1 to 5). There was little difference in his delayed recall of verbal and non-verbal material (performance on the delayed recall index of the WMS-R was <.05th percentile). Only marginal improvement was noted on tests of recognition. In sum, IP's neuropsychological profile was consistent with that reported in anterograde amnesia in which a profound deficit to new learning is present with relative preservation of other cognitive functions.

5.2 Case GS

GS was 33 years of age when he was admitted to hospital with a suspected brain haemorrhage. Initial cranial CT scanning revealed the presence of a subarachnoid haemorrhage in the right fronto-parietal region. This was the result of an aneurysm in the anterior communicating artery which was surgically clipped on the same day of admission. An initial neuropsychological examination was conducted six weeks following the insult. Results of this assessment revealed a pattern of severe memory impairment and slowed rate of information processing together with general preservation of intellectual and executive/frontal lobe functions. Prior to the insult, GS had a variable employment history that included labouring positions and work as a hospital wardsman. He was undergoing rehabilitation when referred for involvement in this study.

GS was seen in May 1996 to determine his suitability for the research program. Initial interviews with his mother revealed that GS had been an aggressive, violent and impulsive person prior to the insult. She reported noticing considerable improvement in his behaviour following the insult and claimed that he had changed for the better. No behavioural difficulties were evident during the examination. On the whole, GS presented as cheerful in manner and co-operated fully with testing procedures.

Results of the assessment are presented in Table 5.2. GS was generally oriented for person and place, but was not oriented for time. Attentional capacity was preserved as was his performance on all tests of visual perception. No language problems were evident in either expression or comprehension. Although his current intellectual ability was found to be in the average range (37th percentile), a mild discrepancy was noted between verbal and performance

General Intellectual Function:

WAIS-R:	Information	9	Picture Completion	12
	Digit Span	8	Picture Arrangement	12
	Vocabulary	12	Block Design	9
	Arithmetic	9	Object Assembly	12
	Comprehension	8	Digit Symbol	5*
	Similarities	8		
			Verbal IQ:	91
			Performance IQ:	99
			Full Scale IQ:	94

Anterograde Memory:

WMS-R:	Verbal Memory Index	74*
	Visual Memory Index	84*
	General Memory Index	73*
	Attention/Concentration Index	99
	Delayed Recall Index	<50*
RAVLT:	Trials 1 - 5 (/15)	6, 6, 5, 5, 7*
	Recall after interference	3/15*
	30 min. recall	3(+2)/15*
	30 min. recognition	12(+2)/15*
Rey Figure:	Copy	36
	3 min. delay	11*
	30 min. delay	10*

Autobiographical Remote Memory:

AMI:	Personal -	Childhood	18.5	Autobiog -	Childhood	9
		Early Adult	19		Early Adult	8
		Recent Life	14.5		Recent Life	5*

Modified Crovitz Technique (10 cue words)		22/30
Semantic Memory:		
Letter Fluency (FAS)		35
Category Fluency:	Total animate	46
	Total inanimate	37
Picture Naming (BORB)		76/76
Comprehension:		
Token Test		163/163
Visual perception:		
Benton's Facial Recognition (long conversion)		49/54
Benton's Judgement Line Orientation (total)		27/30
BVRT: form discrimination		32/32
Executive Functions (additional tests):		
Trailmaking Test:	A: 61" *	B: 117" *

Table 5.2 GS's neuropsychological test profile (Note: * = impairment)

quotients. The majority of scores on verbal subtests tended towards low average apart from that on vocabulary. His mother indicated that prior to the insult he was well-read and this could explain the comparatively good performance obtained on this subtest. Another notable result was obtained on a measure of psychomotor speed which was severely reduced (5th percentile) given both premorbid and current estimates of ability. This impairment in psychomotor speed also seemed to contribute to the reduction in performance observed on one test of executive function (trailmaking test; Part A: < 10th percentile, Part B: 10th - 25th percentile). GS made no errors in either component of this test and furthermore, performed within the expected range on the other tests of executive function administered.

With respect to memory, no evidence of impairment was found on tests of semantic and remote memory functions. In comparison though, performance on all tests of new learning was profoundly reduced. GS experienced considerable difficulty in acquiring new information and his ability to retain this information following interference and time delay was poor (e.g., on the delayed recall index of the WMS-R performance was <.05th percentile). This pattern of memory performance was observed in both verbal and non-verbal domains. Cueing provided some improvement in memory performance on one test of recognition (i.e., RAVLT), but the same degree of facilitation was not observed on other tests of this nature.

Memory performance was reviewed 3 months later and results indicated that there had been no improvement in this function during that time. Overall, the assessment results indicate that GS suffers from a profound impairment to new learning, which is consistent with that reported in cases of anterograde amnesia, together with severe impairment to psychomotor speed. The remaining functions were relatively preserved in comparison.

5.3 Case TG

TG was admitted to hospital in December 1995 having suffered several days of fever, vomiting and acute confusion. She was 36 years of age at the time. Initial cranial CT scans revealed hypodensity in both temporal lobes and this was more marked in the right hemisphere. The MRI scan report noted altered signal intensity in the cortex of both temporal lobe regions and this was extended to the anterior pole in the right hemisphere. These findings, together with lymphocyte count and EEG changes, were reported to be consistent with herpes simplex encephalitis.

As TG recovered from the acute stages of her illness she was confused, disoriented for place and time and she demonstrated no recollection of ongoing events. She confused members of her immediate family during this early phase of her recovery (e.g., thinking her son was her nephew, providing anecdotal evidence of preserved autobiographical memory for generalities). However, this had improved by the time that TG was interviewed for possible inclusion in the present research program. Prior to her illness TG had been trained as a social/welfare officer and was employed most recently in a teaching and counselling capacity.

Early neuropsychological examinations revealed severe impairment of remote memory and new learning. Moderate impairments to executive function and psychomotor speed were also noted. Another examination was conducted in July 1996 as part of the selection criteria for the present research program and these results are presented in Table 5.3. On testing TG was disoriented for time and place. Attentional and visuoperceptive skills were intact. Her performance on a test of general intellectual function was moderately reduced given premorbid estimates (premorbidly TG was estimated to be of above average ability and current performance placed her at the 50th percentile), and a discrepancy was evident in verbal and performance quotients. Mild to moderate

General Intellectual Function:

WAIS-R:	Information	8*	Picture Completion	9*
	Digit Span	11	Picture Arrangement	12
	Vocabulary	13	Block Design	8*
	Arithmetic	7*	Object Assembly	7*
	Comprehension	13	Digit Symbol	7*
	Similarities	10		
			Verbal IQ:	101*
			Performance IQ:	95*
			Full Scale IQ:	99*

Anterograde Memory:

WMS-R:	Verbal Memory Index	68*
	Visual Memory Index	67*
	General Memory Index	61*
	Attention/Concentration Index	112
	Delayed Recall Index	<50*
RAVLT:	Trials 1 - 5 (/15)	4, 6, 6, 5, 5*
	Recall after interference	1(+2)/15*
	30 min. recall	0/15*
	30 min. recognition	13(+27)/15*
Rey Figure:	Copy	36
	3 min. delay	0*
	30 min. delay	0*

Autobiographical Remote Memory:

AMI:	Personal -	Childhood	19	Autobiog -	Childhood	0*
		Early Adult	15		Early Adult	0*
		Recent Life	10*		Recent Life	0*

Modified Crovitz Technique (10 cue words)		8/30*
Semantic Memory:		
Letter Fluency (FAS)		39*
Category Fluency:	Total animate	35
	Total inanimate	36
Picture Naming (BORB)		69/76
Comprehension:		
Token Test		163/163
Visual perception:		
Benton's Facial Recognition (long conversion)		43/54
Benton's Judgement Line Orientation (total)		28/30
BVRT: form discrimination		32/32
Executive Functions (additional tests):		
Trailmaking Test:	A: 41" *	B: 90" *
Wisconsin Card Sorting Test:	5/6 sorts in 128 trials, 22% perseverative responses*	

Table 5.3 TG's neuropsychological test profile (Note: * = impairment)

impairment was found on tests of planning/organisation, problem solving (e.g., block design, 5th - 9th percentile), mental flexibility (trailmaking test, both A and B at 25th percentile) and fluency (40th - 44th percentile). Because these tests were timed it was felt that reduced processing speed contributed to the reduction observed in performance. Category-specific naming deficits were not apparent on picture naming or category fluency tasks. In addition, performance on other tests indicative of semantic memory function was generally preserved (performance on vocabulary and comprehension subtests of the WAIS-R was at the 84th percentile).

Performance on tests of remote memory was poor. Recall of personal semantic memories was impaired from early adulthood. TG's memory for events that had taken place from early adulthood were particularly vague and devoid of content. This, together with reports from her husband, suggest that her retrograde memory deficit for this material covered a period of approximately 20 years. Memory for autobiographical incidents, as evident from all time periods examined on the AMI and the Crovitz task, was particularly poor (TG obtained an average of 1.3 points out of 3 per item). These memories tended to be very general. For example, in response to the cue word *boat*, TG responded "I went on a cruise ship once", but could not provide any more detail. Thus, recall of personal factual details, although impaired, was clearly superior to that for personally experienced events.

In addition, a profound impairment was found on tests of new learning across both verbal and non-verbal domains. TG had no recollection of material being presented at all following distraction or a delay of several minutes. No improvement was provided with cueing and in fact a positive response bias was evident in her recognition performance (e.g., see RAVLT recognition performance where TG made 27 false positive responses). TG's performance in all these areas was reviewed in a subsequent examination conducted 6 months later. Moderate improvement was evident on some tests of executive function (e.g., problem solving, mental flexibility), but her memory performance remained unchanged.

In summary, TG presents with a global disturbance to memory consistent with that observed in the amnesic syndrome in which the two forms of the disturbance, anterograde and retrograde, are present. Performance in the area of executive functioning, although representing a relative strength when compared to that observed in the area of memory, was also moderately impaired.

5.4 Patient summary

As the above profiles indicate, all three patients satisfied the two selection criteria for inclusion in the present research. All patients suffered from a profound deficit to new learning consistent with that observed in anterograde amnesia. One patient, TG, also suffered from retrograde amnesia which was estimated to cover a period of at least 20 years for autobiographical information that was factual nature. Her remote memory disturbance for autobiographical information that was episodic in nature was more severe and appeared to extend back to childhood. In addition, there was no evidence of semantic memory impairment, particularly in relation to conceptual knowledge. All patients had adequate knowledge of the occupations used in investigations of the preservation of memory for generalities phenomenon.

Chapter 6

Accessing knowledge of higher-level categorical relationships in amnesia[1]

The evidence discussed in the previous chapters indicates that patients with anterograde amnesia acquire some novel information. It seems pertinent to ask *how much*, in addition to what type of, information they remember. It is generally agreed that amnesic patients cannot access specific details of episodes or events. Access to detailed knowledge is required to support conscious recollection and to identify the unique features of particular events, and these patients do neither. However, if patients cannot access specific details, can they access partial knowledge represented at higher or more general levels of classification as occurs in dementia? Although there is some evidence to suggest that memory for generalities may be preserved in amnesia, this is limited by an absence of studies explicitly examining discrimination of high- and low-level knowledge. The following chapters address this limitation in the course of investigating the nature of partial knowledge acquisition (Chapters 6 and 7) and retention (Chapter 8) in amnesia.

The three experiments reported in this chapter investigate the dissociation between exemplar and higher-level categorical knowledge in two amnesic patients. Memory for novel face-occupation associations was examined in all studies. The results of Experiment 1 indicated that patients acquired enough knowledge of face-occupation associations to discriminate individuals according

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[1] The material presented in this chapter is reported in Haslam et al. (in press).

to their higher-level occupational grouping (i.e., whether they were educators or tradespeople), but not their specific occupations (i.e., teachers, lecturers, electricians and plumbers). In other words, memory for generality (i.e., higher-level knowledge) was preserved and item-specific knowledge was impaired. In Experiment 2 we introduced a lower level into our occupational hierarchy — subtypes of teacher and lecturer — and found that for at least one patient this modification in study context facilitated access to knowledge (i.e., at the level of teacher/lecturer) that was not available in the previous study. A third experiment was conducted to examine the contribution of direct and indirect testing to the results of these earlier studies. Although we found that indirect tests were more effective than direct tests in accessing higher-level knowledge, there is some indication that this was not the only factor that influenced memory performance.

6.1 Experiment 1: Preservation of memory for generalities in anterograde amnesia

The phenomenon of preserved memory for generalities was first applied to amnesia by Haslam et al. (1997). This study found evidence of differential memory performance on tests of categorical and item-specific knowledge in an amnesic patient. In the course of studying specific picture-name associations, the patient only acquired sufficient knowledge to discriminate novel concepts on the basis of their higher-level semantic category. The present experiment extends these findings in several ways. First, the generalities phenomenon was investigated in another domain — that involving knowledge about people. The latter was chosen because of its applicability to both past and newly acquired knowledge. Second, a different methodology was employed to support comparison of the generalities phenomenon in amnesia and dementia. Specifically, a hierarchical knowledge structure was devised to explicitly examine the differentiation between high- and low-level knowledge in amnesia.

The present experiment examined patients' ability to acquire face-occupation associations to determine whether they could remember any novel information in this domain. Of particular interest was possible evidence of partial knowledge of these associations. Memory at two levels of detail was examined — general and specific. Participants studied face-occupation pairs. The occupations comprised teachers, lecturers, electricians and plumbers (see Figure 6.1, Level II). These formed the *specific* level of detail. The four specific occupations could also be categorized at a *general*, or higher-level of occupational grouping, involving educators and tradespeople (see Figure 6.1, Level I). Although previous research suggests it is unlikely that amnesics would remember specific face-occupation associations, there is evidence from other studies reviewed in Chapter 3 which suggest that these patients can access partial knowledge of studied materials. It was therefore reasoned that amnesic patients might be able to acquire partial memory of face-occupation associations sufficient to support performance at higher levels of categorization. Thus, although these patients were not expected to distinguish between specific types of educator and types of tradesperson, it was hypothesized that they might demonstrate partial knowledge of face-occupation associations by distinguishing educators from tradespeople.

Experiment 1 examined this issue by analysing the nature of errors made when amnesic patients were unable to assign a specific occupation to a face correctly. Preservation of generality would be demonstrated if an incorrectly assigned occupation tended to come from the same superordinate class as the correct occupation.

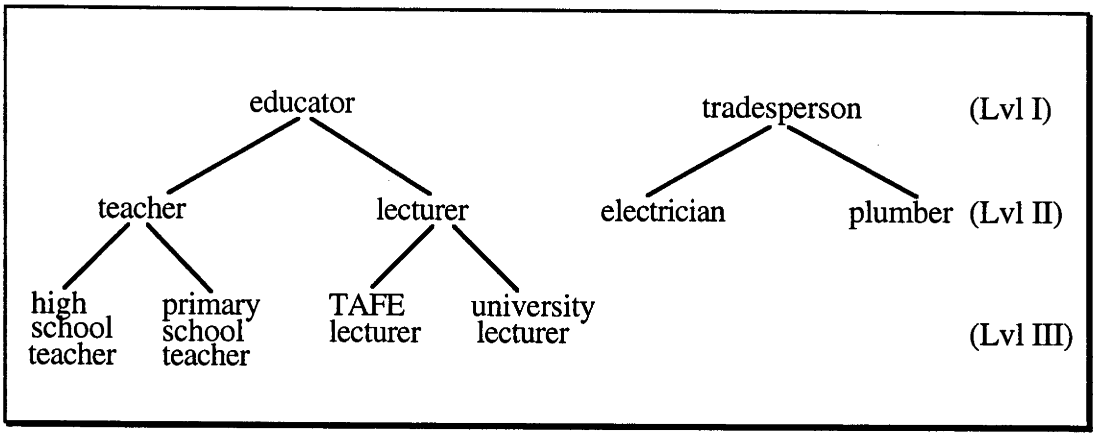


Figure 6.1 The hierarchy of occupations used in Experiments 1, 2 and 3.

Method

Participants

Six people took part. Two participants, IP and TG, were globally amnesic. The relevant history and results of neuropsychological examination for each patient were discussed in Chapter 5. Four non-clinical participants were matched to these patients on the basis of age and sex — two were matched to IP and two to TG.

Materials

Materials consisted of two booklets, a study and test booklet, and a list containing studied occupations.

The study booklet comprised 28 pages. Each page contained a male face and one of four occupations: teacher, lecturer, electrician and plumber. The faces were collected from advertisements in magazines and were both non-famous and unknown. They were scanned into a computer using Adobe Photoshop software to control for factors such as colour, size and background. All faces were printed in black and white on a 600dpi laser printer and were scaled to a width of 8 cm and height of between 10 to 12 cm. Features including age and presence of facial hair were controlled across occupations. Examples of these faces are provided in Appendix 1a. Despite these controls, faces may have provided some cues relevant to the occupation. For example, a particular face may have looked like that of a teacher. However, in a pilot study, a group of participants who had not seen the faces previously (N = 10, mean age = 32 years, SD = 13.98) performed no better than chance in their attempts to identify either specific (i.e., teacher, lecturer, plumber, electrician) or higher-level (i.e., educator, tradesperson) occupations. The pages were ordered randomly in the study booklet with the constraint that no more than two faces from the same occupation appeared after each other.

The test booklet contained the studied faces only without associated occupations. They were also distributed randomly with the same proviso that no more than two faces from the same occupation were presented together. The order of presentation of faces in the test booklet differed from that in the study booklet.

The list of occupations contained the four studied professions written on one line with the types of trade printed alongside the types of educator.

Procedure

The experiment was conducted in two stages: a training phase followed by a delayed recognition phase. Participants were presented with the study booklet and told they would see a series of face-occupation pairs. They were told that the faces were divided equally among four occupations — electricians, plumbers, teachers and lecturers — and that they were to learn the occupation of each person. The training phase consisted of five study/test trials, each comprising a single presentation of face-occupation pairs from the study booklet followed by a recognition test. In the first trial, participants were shown the face-occupation pairs in the study booklet, one at a time, and for each were asked to comment on whether the face matched the occupation (e.g., Does this person look like a plumber?). This ensured that participants processed the face *together* with the noted occupation.

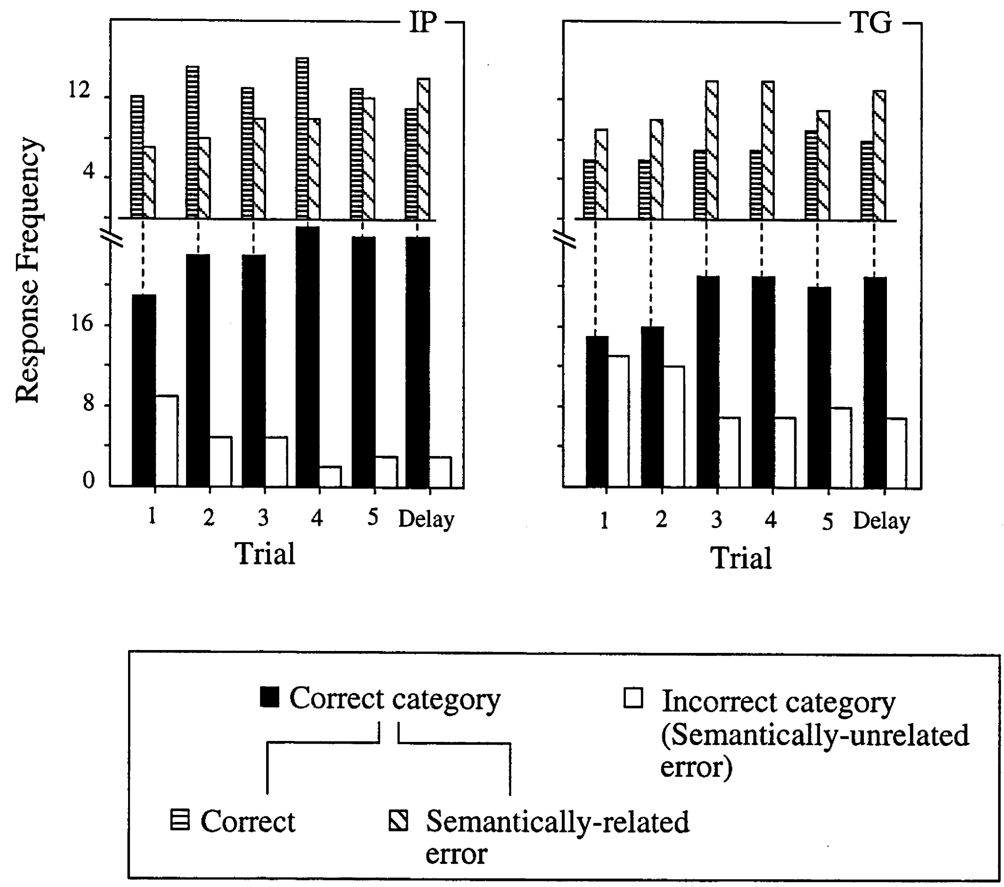
On each trial, after the 28 faces had been presented, participants were immediately shown the test booklet together with a sheet containing the four studied occupations. They were informed that this second booklet contained the faces they had just seen and that their task was to identify the occupation associated with the face. Participants were told that it was alright if they experienced problems in remembering the correct occupation, or any of the faces contained in the booklets, and that under these circumstances they should choose the occupation they felt best matched the person's face. This ensured that a response was given for every face. No feedback regarding the accuracy of recognition performance was given. The study/test procedure was repeated five times.

At the completion of the training phase a distractor task was administered. The distractor task was the digit span test from the Wechsler Memory Scale - Revised (Wechsler, 1987) in which both digits forward and backward were administered. Immediately following this, participants were given a delayed recognition test. They were again presented with the test booklet together with the list of occupations and were asked to choose the profession that matched the face.

Results and Discussion

Response distributions for the five training trials and delayed test are presented separately for IP and TG in Figure 6.2a. In the bottom panel responses have been grouped according to whether the nominated profession fell in the correct category (correct responses and semantically-related errors combined) or the incorrect category (semantically-unrelated errors). In the top panel the correct category responses have been divided into correct responses and semantically-related errors.

(a) Results of Experiment 1



(b) Results of Experiment 2

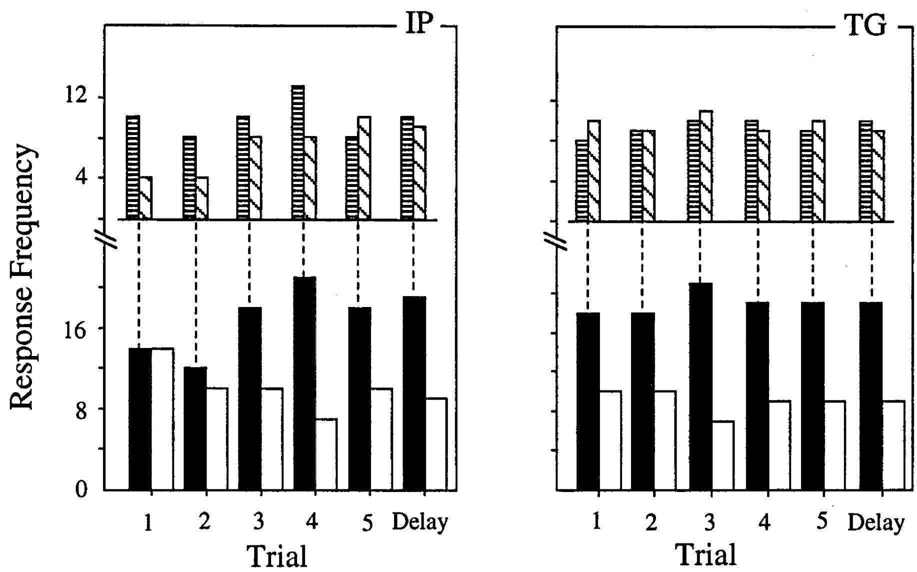


Figure 6.2 Indirect measures of higher-level knowledge in two amnesic patients (a) results of Experiment 1 (educator/tradesperson) and (b) results of Experiment 2 (teacher/lecturer)

As there were four studied occupations, it was expected that 25% of responses would be correct merely by chance. This leaves a 25% chance of selecting an occupation that was semantically-related to the target and a 50% chance of selecting an occupation unrelated to the target. In other words, even if no information had been acquired by participants, 50% of responses were expected to be related (i.e., to fall into the correct category) and 50% were expected to be unrelated to the target (i.e., to fall into the incorrect category). To determine whether memory for higher-level occupational grouping was preserved we compared the frequencies of correct-category responses and incorrect responses (bottom panel). This comparison provided an index of between-category discrimination that indicated whether the participant could differentiate educators from tradespeople irrespective of errors made at the specific level. If no information was acquired about face-occupation associations at this higher level then the frequency of related and unrelated responses should have been equal. To determine whether participants acquired specific knowledge of face-profession associations the frequencies of semantically-related errors and correct responses were compared (top panel). This provided an index of within-category discrimination (i.e., measuring the patients' ability to differentiate at the more specific level of types of educator and types of trade). Again, the frequency of correct responses and semantically-related errors would be equal if specific knowledge of face-occupation associations was not available.

Figure 6.2a shows the performance of the two patients across the five study/test and the delayed recognition trials. IP's between-category judgements (lower panel) show that he was able to categorise faces according to whether they were educators or tradespeople. On the very first exposure to the stimuli there was a (non-significant) difference between correct-category and incorrect-category responses, favouring the former, and the difference between these response types was significant from the second trial in the study phase onwards ($\chi^2(1)_{\text{Trial 2}} = 10.3$, $\underline{p} < .005$; $\chi^2(1)_{\text{Trial 3}} = 10.3$, $\underline{p} < .005$; $\chi^2(1)_{\text{Trial 4}} = 18.8$,

$p < .001$; $\chi^2(1)_{\text{Trial 5}} = 15.8$, $p < .001$; $\chi^2(1)_{\text{Delay}} = 15.8$, $p < .001$). There was no significant difference between semantically-related errors and correct responses on any trial (i.e., within-category judgements — top panel) indicating that IP could not discriminate teachers from lecturers or electricians from plumbers. Together, these results indicate first, that IP had acquired sufficient knowledge of face-occupation associations to discriminate educators from tradespeople, and secondly, that the knowledge acquired was not sufficient to discriminate between types of educator and types of tradespeople.

A similar pattern of accurate between-category and impaired within-category judgements was produced by TG. However, between-category discrimination was not as marked as that found with IP. The difference between the frequency of correct- and incorrect-category responses was significant from the third trial onwards ($\chi^2(1)_{\text{Trial 3}} = 6.04$, $p < .03$; $\chi^2(1)_{\text{Trial 4}} = 6.04$, $p < .03$; $\chi^2(1)_{\text{Trial 5}} = 4.3$, $p < .05$; $\chi^2(1)_{\text{Delay}} = 6.04$, $p < .03$). Thus, by these trials TG had acquired enough knowledge about face-occupation associations to discriminate educators from tradespeople. Like IP, TG showed no evidence of access to more specific details of face-occupation associations. The frequencies of correct responses and semantically-related errors (involved in within-category discrimination) did not differ significantly on any trial and, indeed, there was a bias towards semantically-related errors on each trial. Thus, TG also demonstrated that she had acquired some knowledge of face-occupation associations at the higher-level of educator/tradesperson, but the information available was not sufficient to support discrimination within professional groups. For both patients, memory performance was superior on tests of higher-level categorical knowledge.

To determine whether this pattern of performance was peculiar to our amnesic patients, we administered the same task to matched controls. Controls had no difficulty remembering specific face-occupation associations. Controls matched to TG were accurate in identifying specific occupations from the second trial onwards ($\chi^2(1)_{Trial\ 2} = 7.8$, $p < .01$; $\chi^2(1)_{Trial\ 3} = 13.9$, $p < .001$; $\chi^2(1)_{Trial\ 4} = 15.9$, $p < .001$; $\chi^2(1)_{Trial\ 5} = 16.8$, $p < .001$; $\chi^2(1)_{Delay} = 15.4$, $p < .001$) as did the controls matched to IP ($\chi^2(1)_{Trial\ 2} = 6.9$, $p < .01$; $\chi^2(1)_{Trial\ 3} = 7.0$, $p < .01$; $\chi^2(1)_{Trial\ 4} = 16.0$, $p < .001$; $\chi^2(1)_{Trial\ 5} = 17.4$, $p < .001$; $\chi^2(1)_{Delay} = 9.4$, $p < .005$).

From these results we can conclude that neither patient could remember specific occupations but that in each case their knowledge of higher-level occupational grouping was preserved: IP and TG both discriminated accurately between educators and tradespeople even though their responses within these classes was random. That is, the amnesic patients were showing the same dissociation between loss of information at the specific level and preservation at the general level as previously reported in particular forms of dementia (Chertkow et al., 1992; Funnell, 1995; Hodges et al., 1994, 1995; Martin, 1987). However, as in the case of our earlier patient (Haslam et al., 1997), this phenomenon was here manifested in relation to material acquired *after* the onset of memory disturbance.

6.2 Experiment 2: The role of study context

In Experiment 1 we found that amnesic patients acquired some knowledge of face-occupation associations during study, but the information was only sufficient to categorize faces at the higher-level of classification. Occupations, like other taxonomic hierarchies, span a range of levels of specificity from the most general (works with people) to the most specific (teaches Advanced Chemistry at Fairfield High School). What was it about the particular "general" level used in Experiment 1 (educator/tradesperson) that enabled participants to perform adequately and what was it about the particular "specific" level (subtypes of educator and tradesperson) that hindered memory? One possibility is that performance was *level-specific* — that it was intrinsic to the particular points in the hierarchy that we happened to select. For example, our specific level contained professions that were arguably basic level

"Roschian" categories, while our general level involved superordinate categories (Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976). It is possible then that patients could not acquire new knowledge involving basic level categories.

Alternatively, performance may not have been intrinsic to the levels selected. That is, the results for our categories may reflect the particular semantic context provided by our learning task. In this case the distinction between general and specific classifications may be relative rather than absolute — patients may be able to recall *relatively* general but not *relatively* specific information. This may reflect changes in encoding demands (e.g., the depth of processing) imposed by the study conditions (e.g., see Baddeley, 1982b; Tulving, 1982, 1983; Wiseman & Tulving, 1976). For instance, in the course of studying the face-occupation associations presented in Experiment 1 (i.e., teacher, lecturer, electrician and plumber), information concerning their educator- or trade-related status may be highlighted at the time of encoding as one means of discriminating between people. The latter information, however, will not be particularly useful in remembering more specific face-occupation associations (e.g., subtypes of teacher and subtypes of lecturer) and hence an alternative encoding strategy must be employed.

Experiment 2 examined this question by changing the context of the teacher/lecturer distinction. In Experiment 1, this distinction had been at the specific level within the study context that separated tradespeople from educators (involving Levels I/II in Figure 6.1). In the second experiment the distinction between teacher and lecturer was transformed into the *general* level, by restricting items to educators alone and distinguishing between subtypes of teacher and lecturer (involving Levels II/III in Figure 6.1). In other words, participants were asked to make a coarse occupational discrimination in Experiment 1 and a comparatively fine discrimination in Experiment 2.

The same two amnesic patients studied face-occupation associations, but on this occasion occupations comprised subtypes of teacher and subtypes of lecturer. As in Experiment 1, there were two levels at which knowledge could be demonstrated. Specific knowledge would be demonstrated if patients could discriminate accurately between subtypes of teacher and subtypes of lecturer. Given the performance of our patients in the earlier experiment, discrimination of faces at this specific level seemed unlikely. Preservation of higher-level knowledge, would be demonstrated if patients discriminated teachers from lecturers. This higher-level occupational grouping represented the specific level of detail in the previous experiment. The question of interest in this experiment was whether knowledge at the level of teacher/lecturer could be demonstrated in the new study context.

Method

Participants

The two amnesic patients, IP and TG, who participated in Experiment 1 also took part in this second experiment. Additional participants included four new matched controls, two of whom were paired with IP and two with TG.

Materials

Novel face-occupation associations were introduced in this experiment. The study booklet comprised 28 pages with a single male face and profession presented on each page. Occupations comprised high school teachers, primary school teachers, university lecturers and TAFE lecturers (i.e., lecturers at a college of Technical and Further Education). The test booklet contained studied faces only. A sheet listing the four studied occupations on a single line was also used in conjunction with the test booklet — subtypes of teacher were followed by subtypes of lecturer.

Faces were collected from magazine advertisements and were both non-famous and unknown. They were scanned into a computer and reproduced using the procedure employed in Experiment 1 (see Appendix 1b for examples of these faces). Size, colour, background and mode of presentation were all consistent with those employed in our earlier experiment. Factors such as age and presence of facial features (i.e., facial hair and glasses) were controlled across professional groups. Results of pilot testing indicated that faces did not cue occupation. Participants in the pilot study ($\underline{N}$ = 10, mean age = 32 years, SD = 13.98) were no better than chance in identifying either specific (i.e., primary school teacher, high school teacher, TAFE lecturer, university lecturer) or higher-level (i.e., teacher, lecturer) occupations.

Stimuli were presented in a random order in each booklet with the constraint that no more than two faces from the same occupation were presented after each other. The order of stimulus presentation in the study booklet differed from that in the test booklet.

Procedure

The general procedure employed in the current experiment was identical to that used in Experiment 1. Thus, participants were presented with five study/test trials, a distractor task and a delayed test trial. The distractor task used on this occasion was the digit span test from the Wechsler Adult Intelligence Scale - Revised (Wechsler, 1981).

Results and Discussion

The data analysis paralleled that for Experiment 1. The matched controls were accurate in making within-category judgements after only a few study/test trials. These subjects had no difficulty remembering specific face-occupation associations and could discriminate primary from high school teachers as well as university from TAFE lecturers. This was evident from the second trial onwards for controls matched to TG ($\chi^2(1)_{Trial\ 2} = 9.8$, $\underline{p} < .005$; $\chi^2(1)_{Trial\ 3} = 10.2$, $\underline{p} < .001$; $\chi^2(1)_{Trial\ 4} = 23.1$, $\underline{p} < .001$; $\chi^2(1)_{Trial\ 5} = 20.1$, $\underline{p} < .001$; $\chi^2(1)_{Delay} = 15.4$, $\underline{p} < .001$) and from the third trial for controls matched to IP ($\chi^2(1)_{Trial\ 3} = 11.9$, $\underline{p} < .001$; $\chi^2(1)_{Trial\ 4} = 16.5$, $\underline{p} < .001$; $\chi^2(1)_{Trial\ 5} = 17.0$ $\underline{p} < .001$; $\chi^2(1)_{Delay} = 15.4$, $\underline{p} < .001$).

The results for the patients are presented in Figure 6.2b (on page 99). As expected, there was no evidence of discrimination at the specific level (subtypes of teacher and lecturer — upper panels). Within-category discrimination was no better than chance on all trials for both patients. With respect to performance at the higher-level occupational grouping, the results were less clear than those obtained in the first experiment. However, there was evidence of improvement in performance with the change in study context for at least one patient. Between-category discrimination (lower panels) was better than chance on all trials for TG and on the last four trials for IP. This effect was either significant (trial 4 for IP and trial 3 for TG , $\chi^2(1) = 6.04$, $p<.03$ in both cases), or narrowly failed to reach significance in each case (all p's ranged from .09 to .19).

It was possible that the failure to reach significance in these cases reflected insufficient training. To examine this issue, the experiment was repeated several weeks later but this time the amount of training was doubled (i.e., 10 learning trials were administered instead of 5). No improvement in overall memory performance was found. Neither patient could discriminate people on the basis of their specific occupations. In addition, between-category judgements were only significantly better than chance on two trials for each patient (i.e., Trial 10 and the delayed recognition trial for IP and Trials 9 and 10 for TG, $\chi^2(1) = 6.04$, $p<.03$ in all cases). Thus, additional training led to no improvement in memory performance for either patient.

Further evidence of an improvement in performance with change of context, for TG at least, is provided by direct comparison between performance in Experiments 1 and 2. We compared within-category discrimination for the educator-related occupations in Experiment 1 (where teacher/lecturer was the specific level) with between-category discrimination in Experiment 2 (where teacher/lecturer was the general level). The top panels in Figure 6.3 show performance when the teacher/lecturer distinction represented the specific level (Experiment 1) and the bottom panels show performance when these occupations

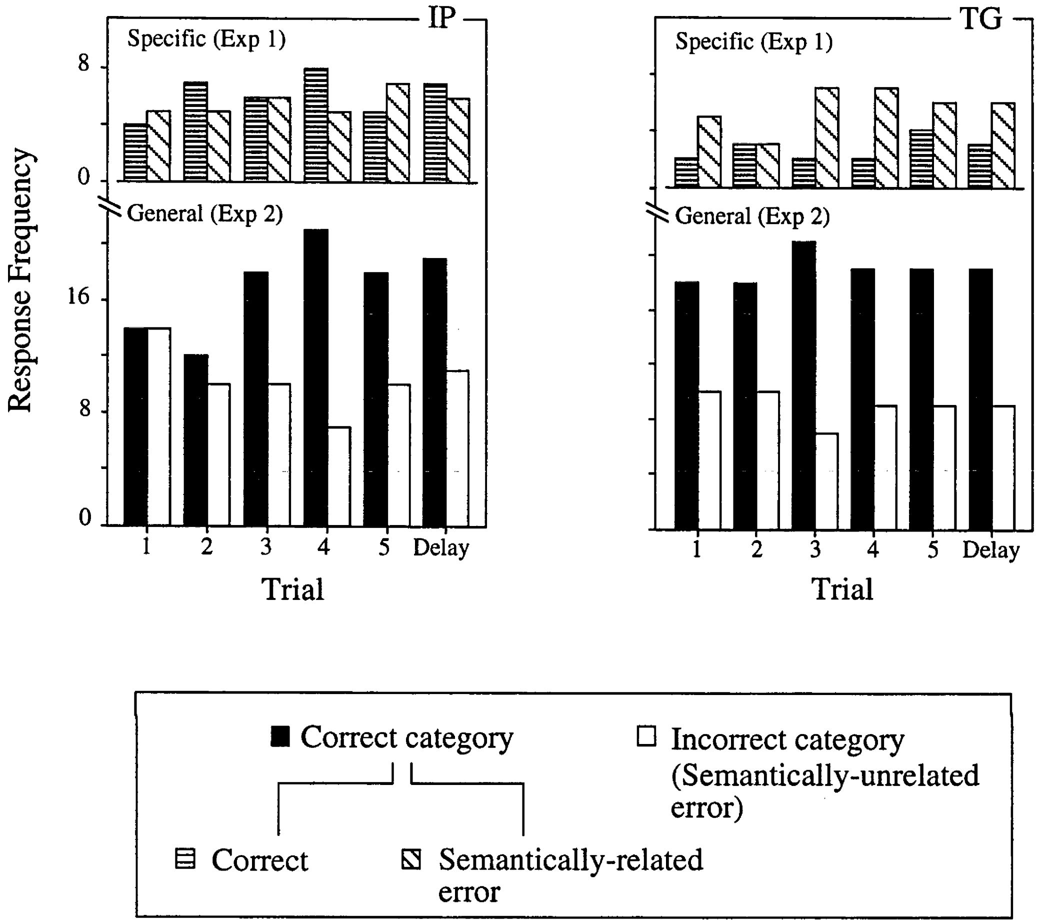


Figure 6.3 Comparison of Experiments 1 and 2: Direct and indirect measures of knowledge at the level of teacher/lecturer in two amnesic patients.

represented the general level (Experiment 2). TG's ability to discriminate teachers from lecturers was significantly better in the second experiment on Trials 3 and 4 ($\chi^2(1)_{\text{Trial 3}} = 6.0$, $p<.001$; $\chi^2(1)_{\text{Trial 4}} = 5.1$, $p< .001$). There was no difference in IP's ability to discriminate faces at the level of teacher/lecturer in the two experiments. For this patient there was therefore no direct statistical evidence of an improvement in Experiment 2.

In view of the less-than-conclusive results of these analyses, we sought further evidence of memory for higher-level occupational grouping by examining the patterning of responses to individual items across trials. As noted, in the lower panel of Figure 6.2b, there was a majority of correct-category responses on most trials. Superficially, this repeated pattern would seem to provide evidence of learning. However, this is misleading if there is a correlation between responses given to particular items on different trials. Cross tabulations of responses (correct/incorrect category) between pairs of trials confirmed the existence of intertrial correlation for between-category discrimination (correlations ranged from 0.2 to 0.7). That is, the patients tended to make the same general class of response across consecutive pairs of trials. If they responded "teacher" to a particular face on one trial then they were more likely to respond with either "teacher" or "lecturer" on the next trial. We considered the possibility that this pattern of repetition might provide further evidence of an acquired memory trace. It was argued that if response repetitions were based on memory for the studied items (as opposed, for example, to cued guessing — "this person looks like a teacher"), then correct responses would be more likely to be repeated on consecutive trials than incorrect ones.

An index of response repetition was calculated by expressing the number of same-class responses (both correct/both incorrect) for each pair of consecutive trials as a proportion of the number of responses in that class on the second of the pair (e.g., if 10 items were identified correctly on both trials and 12 items were correct on the second administration, the proportion of consecutively correct responses was 0.8). These measures are presented in Table 6.1. For TG, repetition of correct between-category responses was more likely than repetition of incorrect ones in every case, indicating retention of some information about higher-level occupational grouping, and supporting the analysis of her overall accuracy data. For IP the proportion of correct responses was greater than incorrect in the last pairing only (i.e., T4/T5), providing little evidence of retention. Again, this was consistent with his overall performance in this experiment.

Patient	T1/T2	T2/T3	T3/T4	T4/T5
IP	0.8 : 0.8	0.6 : 0.8	0.9 : 1	0.8 : 0.4
TG	0.8 : 0.5	0.7 : 0.4	0.8 : 0.4	0.8 : 0.6

(T1 = trial 1; T2 = trial 2; T3 = trial 3; T4 = trial 4; T5 = trial 5)

Table 6.1 Proportion of correct to incorrect category responses across consecutively paired study/test trials in amnesic patients.

In Experiment 1, neither patient could distinguish between teachers and lecturers when these constituted lower-level occupations. Considered as a whole, the results of Experiment 2 suggest that at least one of our patients could discriminate between the teachers and lecturers when the context was changed so that these constituted the higher-level occupational grouping. This would imply that the performance in Experiment 1 was not intrinsic to the absolute levels of categorisation used there, but rather that the status of a category as "high" or "low" may be defined relative to the context provided by the learning task. In other words, the study context alters the manner in which information is processed. If there is little difference between studied items (e.g., high school teacher, primary school teacher) then the knowledge supporting their discrimination must be reasonably specific and such knowledge requires a greater depth of processing at the time of encoding. As the difference between studied items increases, the depth of processing required for discrimination decreases.

6.3 Experiment 3: Direct examination of higher-level knowledge

In both of the preceding experiments, the patients were unable to assign items to the correct professional category. However, their errors indicated preservation of information about higher-level category membership. This was interpreted as evidence of impaired memory for specific material, but of preservation of memory for generalities. However, there is another possible explanation of these results: they may be a consequence of the different measures used to assess knowledge at the two levels. Knowledge at the higher-level was expressed indirectly, while knowledge at the lower-level required explicit recall of the material. It is possible that indirect measures yield superior performance in amnesics, and that our patients would not have been able to distinguish, educators from tradespeople say, if asked to do so directly. This analysis is consistent with implicit-explicit theory (discussed in Chapter 2) in which a distinction is made between tests that refer to previous study episodes (i.e., explicit or direct memory tests) and those that do not (i.e., implicit or indirect memory tests). In this theory it is argued that amnesic patients can demonstrate knowledge when their memory is tested implicitly but not when it is tested explicitly. To examine this question concerning the influence of direct and indirect memory tests, the same two patients were presented with the same face-occupation associations used in Experiments 1 and 2, but at test they were asked to nominate the higher-level occupational grouping (educator/tradesperson or teacher/lecturer) explicitly.

Method

Participants

Participants included IP, TG, two controls matched to IP and two controls matched to TG. Controls who took part in the current experiment had not participated in the earlier experiments.

Materials

Materials consisted of the study and test booklets used in Experiments 1 and 2 as well as two lists of occupations. One list contained the professions "educator" and "tradesperson" on a single line and this was presented with materials from Experiment 1. The other list contained the professions "teacher" and "lecturer" on a single line and this was presented with materials from Experiment 2.

Procedure

There were two parts to the experiment. The first part involved direct examination of knowledge at the higher-level of educator/tradesperson and the second part involved direct examination of knowledge at the higher-level of teacher/lecturer.

(i) Knowledge of educator/tradesperson: The materials and training procedure were identical to those employed in Experiment 1. There were five study/test trials, in which four specific occupations were studied (i.e., teachers, lecturers, electricians and plumbers), followed by administration of a distractor task and then a delayed recognition test. The test procedure generally followed that of the earlier experiment, but participants were given a forced choice between "educator" and "tradesperson" instead of a list of specific occupations. The delay between administration of Experiment 1 and the current phase of the final study was approximately one month for IP and three months for TG.

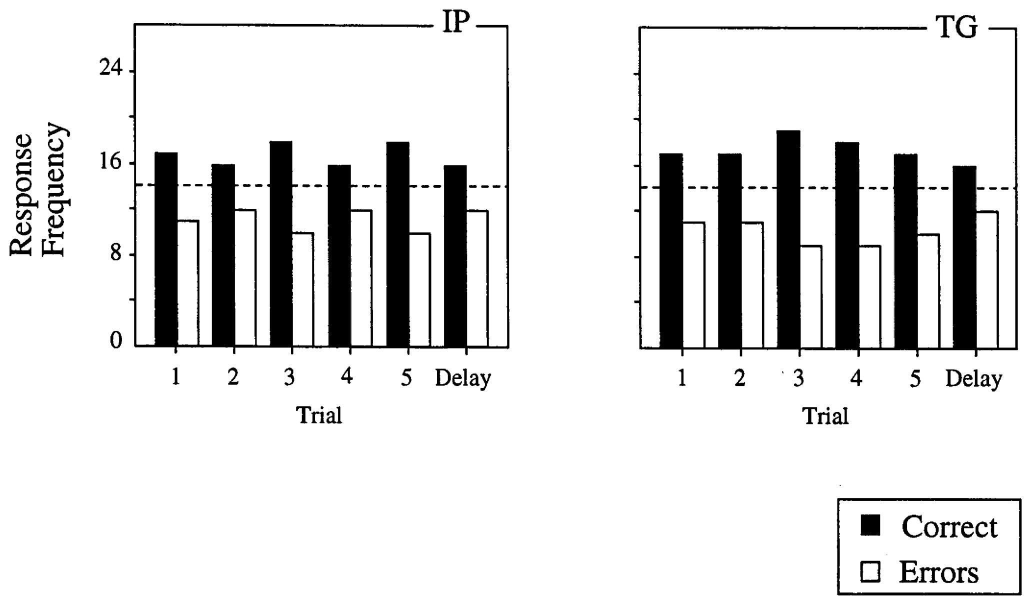
(ii) Knowledge of teacher/lecturer: The general procedure used to examine knowledge at the level of teacher/lecturer directly was essentially the same as that employed in Experiment 2. Five study/test trials were administered in which the specific occupations high school teachers, primary school teachers, university lecturers and TAFE lecturers were studied. This was followed by administration of a distractor task and then a delayed recognition test. Face-occupation associations and the distractor task were identical to those used in Experiment 2. In each of the five study/test and delayed recognition test trials participants were asked whether the face belonged to a "teacher" or "lecturer". The delay between administration of the second experiment and the current phase of this final study was at least three months for both patients.

Results and Discussion

The frequencies of correct and incorrect responses to higher-level occupational categories are presented in Figure 6.4. Results for educator/tradesperson are presented in Figure 6.4a and results for teacher/lecturer are presented in Figure 6.4b.

(i) Knowledge of educator/tradesperson: When knowledge about educators and tradespeople was examined directly, both TG and IP showed a tendency to choose the correct higher-level occupational grouping on all trials. However, the difference between correct and incorrect responses was not significant on any trial. This suggests that when explicit reference was made to these higher-level occupations memory performance was not as good as that in Experiment 1 where it was tested indirectly. In contrast, controls matched to TG were significantly better than chance in identifying the correct higher-level profession from the first study/test trial ($\chi^2(1)_{\text{Trial 1}} = 7.0$, $p < .01$; $\chi^2(1)_{\text{Trial 2}} = 8.0$, $p < .005$; $\chi^2(1)_{\text{Trial 3}} = 15.8$ $p < .001$; $\chi^2(1)_{\text{Trial 4}} = 14.3$, $p < .001$; $\chi^2(1)_{\text{Trial 5}} = 15.8$, $p < .001$; $\chi^2(1)_{\text{Delay}} = 18.9$, $p < .001$) while those matched to IP were better than chance from the

(a) Educator/tradesperson



(b) Teacher/lecturer

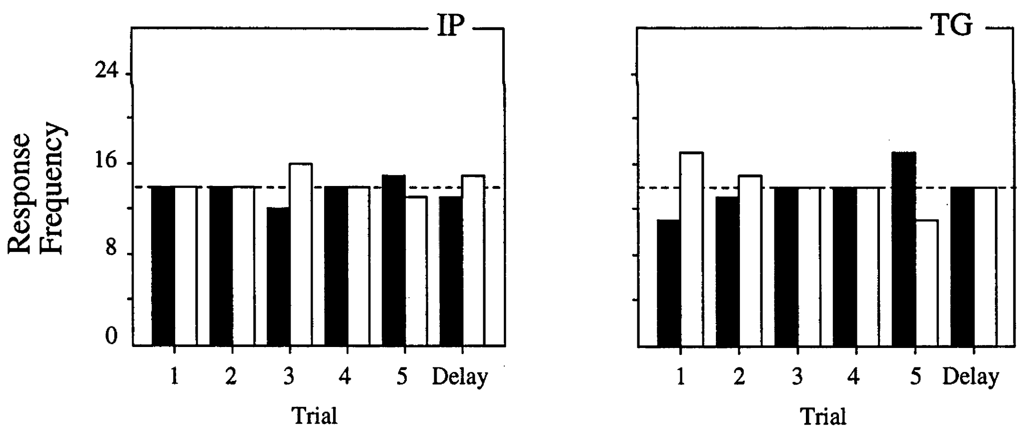


Figure 6.4 Results of Experiment 3: Direct measures of knowledge at the higher level of (a) educator/tradeperson and (b) teacher/lecturer in two amnesic patients.

second study/test trial ($\chi^2(1)_{\text{Trial 2}} = 5.1$, $p< .03$; $\chi^2(1)_{\text{Trial 3}} = 10.3$, $p< .005$; $\chi^2(1)_{\text{Trial 4}} = 8.0$, $p<.005$; $\chi^2(1)_{\text{Trial 5}} = 10.3$, $p< .005$; $\chi^2(1)_{\text{Delay}} = 10.3$, $p<.005$).

(ii) Knowledge of teacher/lecturer: When knowledge about teachers and lecturers was tested directly, IP and TG performed at chance, indicating that both patients had insufficient knowledge to make such a judgement. On the other hand, controls had no difficulty performing this task. Controls matched to TG made significantly more correct higher-level judgements from the second trial onwards ($\chi^2(1)_{\text{Trial 2}} = 8.0$, $p< .005$; $\chi^2(1)_{\text{Trial 3}} = 15.8$, $p< .001$; $\chi^2(1)_{\text{Trial 4}} = 20.6$, $p<.001$; $\chi^2(1)_{\text{Trial 5}} = 22.3$, $p< .001$; $\chi^2(1)_{\text{Delay}} = 22.3$ $p<.001$) as did controls matched to IP ($\chi^2(1)_{\text{Trial 2}} = 9.1$, $p< .005$; $\chi^2(1)_{\text{Trial 3}} = 18.9$, $p< .001$; $\chi^2(1)_{\text{Trial 4}} = 26.0$, $p<.001$; $\chi^2(1)_{\text{Trial 5}} = 24.1$, $p< .001$; $\chi^2(1)_{\text{Delay}} = 24.1$, $p<.001$).

These results suggest that the manner in which knowledge is expressed (i.e., directly or indirectly) does influence memory performance in these patients. Although they were unable to recall higher-level occupations explicitly, in the earlier experiments retention of information at this level was implied by their errors when recalling lower-level occupations. This finding speaks to the question of whether the results of Experiments 1 and 2 were due to differences in response mode rather than enhanced recall of higher-level category. Experiment 3 suggests that the good performance at the level of educator/tradesperson was made possible by the indirect nature of our test. It is also possible (though this does not necessarily follow) that performance at the specific occupational level (i.e., types of educator and types of trade) was due to the *explicit* nature of the response required. The results of Experiment 2 appear to support this suggestion since at least one patient showed improved performance at the teacher/lecturer level when this was tested indirectly.

6.4 Conclusions from Experiments 1 to 3

The primary aim of these experiments was to provide further evidence of preserved memory for generalities in amnesia. This was demonstrated most clearly in Experiment 1. In this experiment, patients were unable to recognize the specific occupations associated with particular faces but, nonetheless, their responses preserved the higher-level occupational grouping of educator and tradesperson. This result confirms previous reports that, in spite of their memory impairment, amnesic patients are capable of acquiring new information (e.g., Hirst, et al., 1988; Van der Linden, Meulemans & Lorrain, 1994). However, the information these patients acquired supported high-level but not low-level categorical distinctions.

The influence of study context was investigated in Experiment 2 and it was found that this factor affected the performance of one patient. Although TG had not distinguished between specific types of educator in the previous experiment, her responses preserved this distinction in Experiment 2 when it constituted a higher-level grouping of specific subtypes of teacher and lecturer. Though not conclusive, this finding suggests that a "generality" is at least partly defined with respect to the context in which information is encountered. One implication of this, if we accept that memory for generalities is preserved in amnesia, is that knowledge at any level might be acquired by these patients provided the learning conditions ensure a semantic representation at an appropriate level of specificity.

Experiment 3 examined the contribution of response mode (i.e., direct and indirect testing) to the results of Experiments 1 and 2. Results of these earlier experiments suggested that memory for generalities was preserved in these patients, and particularly in patient TG. Alternatively, it is possible that the differentiation on tests of high- and low-level knowledge is a consequence of indirect testing procedures used in earlier experiments. Results of Experiment 3 indicated that neither patient could directly identify the higher-level occupation associated with a face, even though response confusions in the earlier studies had implied retention of knowledge at this level. From this it can be concluded that indirect measures were more effective than direct ones in accessing patients' residual knowledge.

The difference in performance on direct and indirect tests might suggest that the apparent preservation of memory for generalities observed in earlier experiments was simply an effect of response mode. If item-specific knowledge was impaired because it was tested directly, then an indirect test for the same lower-level detail should improve memory performance. In fact this test was provided in Experiment 2 and there was indeed some improvement in memory performance at the teacher/lecturer level for TG when this was tested indirectly. However, the effect was confined to this one patient. IP did not discriminate teachers from lecturers in either experiment and his performance at the higher-level in Experiment 1 (i.e., educator/tradesperson) was better than that at the higher-level in Experiment 2 (i.e., teacher/lecturer). On this basis we can conclude that, for IP at least, the preservation of memory for generalities in Experiment 1 was not simply a consequence of response mode.

As noted earlier, the implicit-explicit dissociation might be invoked to account for the finding that amnesic memory for higher-level categorization was facilitated by the use of indirect tests. In particular, the evidence here for preservation of memory for generalities was based on contrasting the poor memory for specific occupations (cf. explicit) and the relatively good identification of occupational grouping (cf. implicit). However, there are important differences between our procedure and those employed in traditional implicit memory tests. Unlike other studies where effects of previous exposure are manifested in tasks which do not require explicit recall, our tasks *always* required explicit recall (i.e., in all studies patients were asked to identify the person's occupation directly). In our case, the "implicit" knowledge was manifested in the pattern of failure of explicit memory. It is not sufficient to explain this result as yet another case of implicit memory phenomena. Indeed to invoke a universal implicit memory to explain all cases of preserved memory in the brain impaired is not an adequate appraisal. Each manifestation of "implicit memory" requires its own particular explanation. There is no reason to expect that a postulated "implicit memory", indicated by a correct choice of higher-occupational grouping, would bear any relationship to the "implicit memory" indicated by, say, stem-completion.

There are a number of conclusions that can be drawn from results of these experiments. First, it is clear that amnesic patients acquire novel information. This information is sufficient to make high-level but not low-level judgements when knowledge is examined indirectly. Having found a differentiation between exemplar and higher-level knowledge in amnesia, it can also be argued with reasonable certainty that preservation of memory for generalities is not confined to patients suffering dementia.

However, conclusions relevant to the possible structure of memory representations in amnesic patients are more tentative. It is possible that the information the patients acquired was confined to relatively abstract properties of stimulus materials. Yet the difference in performance on direct and indirect tests suggests that patients had not simply acquired higher-level knowledge. There must be an additional feature of their memory that facilitates performance on indirect tests, though it is not clear what this feature may be. At this point, there is also some uncertainty about the role of response mode in demonstration of the generalities effect in amnesia. There is some suggestion that at least one patient's performance (IP) was not influenced by response mode, but on its own this finding is inconclusive. Although results of these experiments raise some doubts about the role of response mode, some clarity on this issue was obtained in a subsequent experiment conducted with non-clinical participants (see Chapter 9). Suffice it to say that results of the latter study provided clear evidence that the generalities phenomenon is not simply a consequence of testing conditions.

Although the preservation of memory for generalities observed in amnesic patients in these experiments is similar to that reported in dementia, there is one important difference between these groups in terms of the influence of response mode. Patients with dementia are capable of providing higher-level information about concepts explicitly. However, as Experiment 3 showed, amnesic patients only revealed memory for higher-level information when their knowledge was examined indirectly. It is possible that the latter patients are only capable of remembering "generalities" under these circumstances. Alternatively, it is also possible that amnesic patients performed poorly on direct tests because the knowledge levels employed in these experiments were not sufficiently general. The question of whether there are levels of generality at which amnesic patients can demonstrate knowledge directly is examined in Chapters 7 and 8.

Chapter 7

Amnesic memory for generalities: Can knowledge of higher-level associations be accessed directly?

In Chapter 6 evidence of preserved memory for high-level associations and impaired memory for low-level associations was found in two amnesic patients. However, the effect was only demonstrated when higher-level knowledge was examined indirectly. The patients could not explicitly report the higher-level category in Experiment 3 (i.e., discriminate educators from tradespeople or teachers from lecturers), although their errors indicated that this knowledge was available under indirect testing conditions. One interpretation of this result is that amnesic patients are only capable of accessing higher-level knowledge *indirectly*. Alternatively, it is possible that the level of categorization in the previous experiments was not sufficiently general for patients to demonstrate their knowledge explicitly. To investigate this, another experiment was conducted which examined memory for information that was more general than that investigated in the previous studies. Participants were asked to study face-name-occupation associations. As in Experiment 3, knowledge was assessed by asking a series of direct questions. The level of detail tapped by these questions ranged from the very general to the very specific. It was found that the patients could indeed provide some higher-level information directly. Furthermore, the level of generality at which this was possible varied between patients.

7.1 Experiment 4: Accessing higher-level knowledge directly

The aim of this experiment was to determine whether amnesic patients could directly report any knowledge of higher-level associations. Results of Experiment 3 indicated that the patients could not access knowledge directly at the highest level examined (i.e., at the level of educator/tradesperson). Accordingly, if they were capable of accessing any knowledge directly then it was likely to be at a level that is higher than that represented by educator/tradesperson. However, since there were no clues as to what this level might be, we therefore examined knowledge at a range of levels of varying degrees of specificity.

Patients were again asked to study a series of face-name-occupation associations. Direct access to knowledge about these associations was examined by asking a series of questions. These questions made explicit reference to details about people encountered at study (e.g., "Is this person a musician?"). Knowledge was probed in this manner at several levels. The levels in the knowledge hierarchy were created according to a principle of "sharedness" (see Figure 7.1). At the most general level 20 targets shared the attribute in question, and this number decreased with increasing specificity. For instance, at the top of the knowledge hierarchy participants were asked to indicate whether they were familiar with the person's face and name. In this case all the people studied shared the attribute of "familiarity". At the lowest end of the knowledge continuum, patients were asked to provide the name of the person — an attribute that was unique to the person in question. It was anticipated that if patients were capable of accessing some information directly then it was most likely to occur at the top of the hierarchy. That is, they would be more likely to provide accurate information in response to questions tapping the most general levels of knowledge. In addition, it was likely that they would reach a point beyond which they could no longer provide accurate information. As indicated in Figure 7.1, five levels of knowledge were examined.

In summary, Experiment 4 examined the patients' capacity to access higher-level information about studied people explicitly. The amount of information they could provide was determined by their responses to a series of direct questions which were used to elicit knowledge about these people.

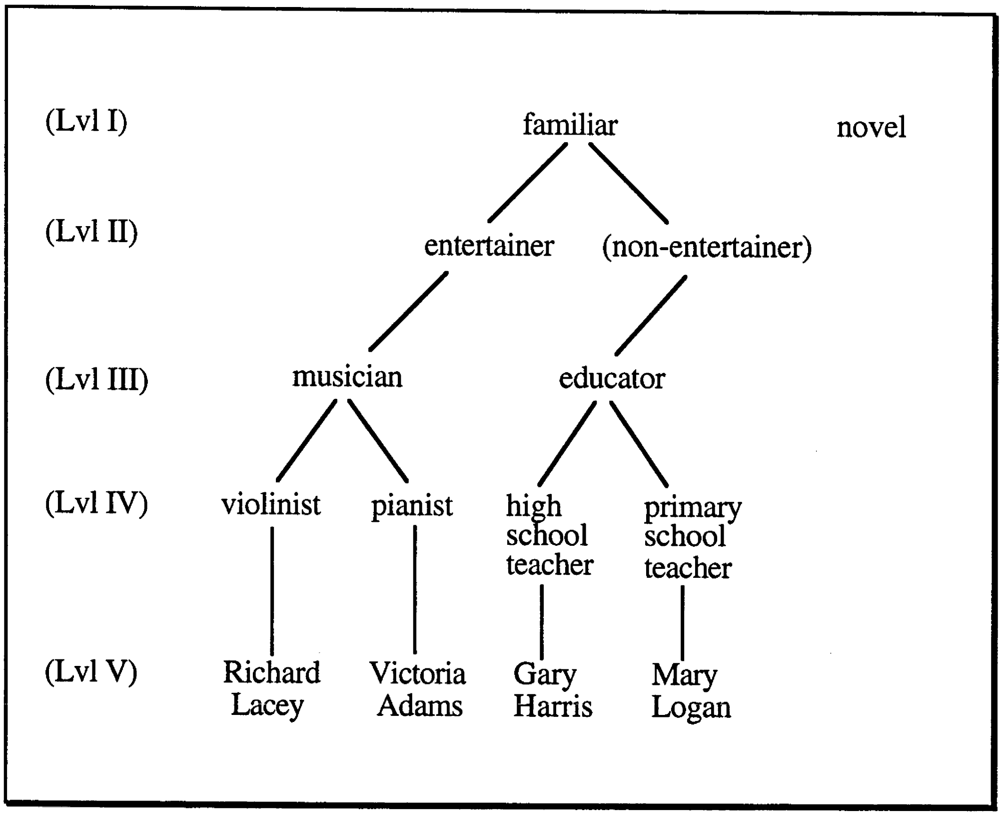


Figure 7.1 The hierarchy of knowledge levels used in Experiment 4

Method

Design

The experiment had two phases: a study phase and a test phase. In the study phase participants were shown the names and faces of 10 musicians and 10 educators. There were two groups of musicians, consisting of pianists and violinists, and two groups of educators, consisting of high school and primary school teachers. In the test phase five levels of knowledge were examined and these comprised: familiarity, general occupational category (i.e., entertainer or not), basic occupational category (i.e., musician/teacher), specific occupational category (i.e., subtypes of teacher and subtypes of musician) and name (see Figure 7.2 for an outline of the design). The dependent measure was memory performance and this was determined by responses to yes/no recognition and two-alternative forced choice.

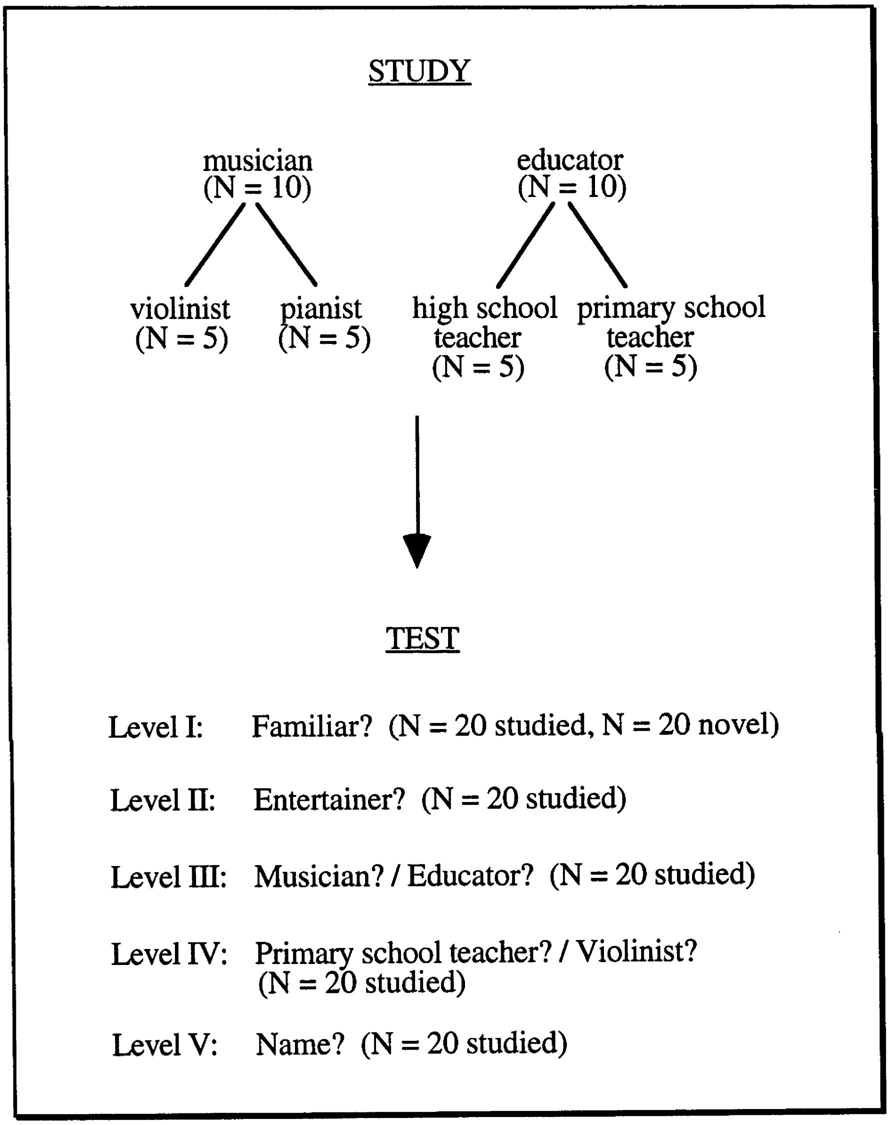


Figure 7.2 Design of Experiment 4

Participants

Nine people took part, comprising three amnesic patients — IP, TG and GS — and six controls. Two controls were matched with each patient on the basis of age and sex.

Materials

The materials consisted of a study booklet, a test booklet, a set of face cue cards and a set of name cards.

The study booklet comprised 20 pages. Each page contained a face, a name (both first name and surname) and an occupation. The faces were collected from advertisements in magazines and were both non-famous and unknown. Responses from a small group of first year psychology students (N = 9, mean age = 21 yrs, SD = 2.1) confirmed that these faces were unfamiliar. The faces were scanned into a computer and reproduced using the same procedure employed in Experiments 1 to 3. Thus, size, colour, background and mode of presentation were all consistent with those employed in the previous experiments. Half the faces were male and the remainder were female. Examples of these faces are presented in Appendix 2a.

Each face was assigned one of four occupations: high school teacher, primary school teacher, violinist and pianist. An equal number of males and females were allocated to teaching and musical occupations. A name was also assigned to each face. Surnames were selected from the local telephone directory. They were reasonably common (i.e., at least 15 people or more with that name) and comprised two syllables which did not constitute a meaningful word (e.g., surnames like "Baker" were not used). Common first names were added to the surnames (see Appendix 2b for a list of these names). The face-name-occupation associations were ordered randomly in the study booklet with the added constraint that people from the same occupation did not appear after one another.

The test booklet contained 40 pages — two pages relevant to each person studied. The first page in the pair consisted of a face together with the questions "Name?" and "Profession?". The second page in the pair contained the answers to these questions. Again, these pairs of pages were distributed randomly in the booklet with the proviso that information about people from the same profession were not presented together. The order of presentation in the test booklet differed from that in the study booklet.

The face cue cards, used to elicit information at each level, consisted of 40 faces. Half of these had been studied and the remainder were non-studied. The non-studied faces were matched as closely as possible to the studied faces with respect to age and sex. The latter faces were scanned into a computer and reproduced using the same procedure as that for studied faces (see Appendix 2c for examples of these faces).

The name cards were used with face cues to probe knowledge about face-name associations and there were two types of cards as indicated in Figure 7.3. One type (illustrated in Figure 7.3a), contained a single name (both first name and surname) and the other type (illustrated in Figure 7.3b) contained a pair of names. Half of the single name cards contained correct names and the remainder contained incorrect names. The incorrect names consisted of an accurate first name and a modification of the surname in which the second syllable was changed (e.g., Mary Logan was changed to Mary Lomas, see Appendix 2b). The name pair cards contained two studied names both from the same gender and from the same basic occupational category (i.e., they were both names of teachers or names of musicians). The position of the correct name varied so that half the time it was the first name and half the time it was the second name.

<u>Procedure</u>

As in the previous experiments there were two phases: a study phase and a test phase. The study phase was conducted over four days. On the fifth day memory was examined.

There were two training sessions per day in the study phase, with a delay of several hours between administration of the first and second session. At the commencement of each session, participants were presented with the study booklet and were told that it contained a series of face-name-occupation associations that they were to remember. For each association they were asked to

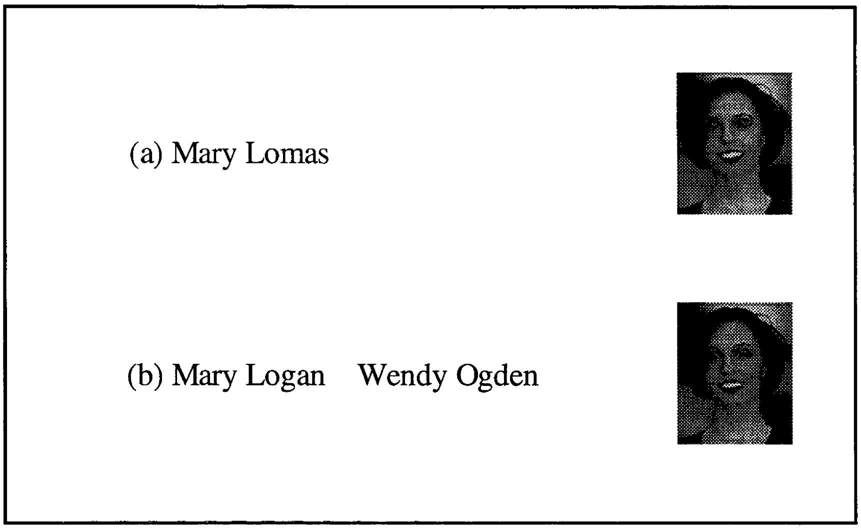


Figure 7.3 The two types of name cards used to test knowledge for face-name associations: (a) single name card and (b) name pair card.

comment, first, whether the name was appropriate for the person (e.g., "Does this person look like they could be named Mary Logan?"), and second, whether the occupation matched the person (e.g., "Does this person look like a primary school teacher?"). These questions required a yes/no response. The purpose was to ensure that participants processed the relevant information to a sufficient depth by making them attend to the relationship between the face, name and occupation.

After the 20 items had been presented, participants were shown the test booklet. They were informed that this second booklet contained the faces they had just seen and that their task was to name each person and identify their occupation. For each item, regardless of the accuracy of their responses, participants were shown the answers to questions concerning the person's name and occupation and they read them aloud. This procedure was followed for the remaining training sessions during the study phase. Each training session took no more than 15 minutes.

The test phase was conducted on the fifth day. Face cues were used to elicit information at five levels of knowledge. The questions presented at these levels proceeded in sequence from the very general (Level I) to the very specific (Level V). They required either a yes/no response or a forced-choice judgement. The questions at each level were as follows:

Level I: "Is this person familiar?"

Level II: "Is this person primarily in the entertainment industry?"

Level III: "Is this person an educator?" or "Is this person a musician?"

Level IV: "Is this person a primary school teacher?" or
"Is this person a pianist?"

Level V: "Is this person's name _______?"<br>"Is this person's name _______ or _______?"

Forty face cue cards, comprising studied and non-studied faces, were presented individually and randomly to test performance at Level I. From the second level onwards only the studied faces (i.e., N = 20) were presented. All items relevant to Level I were presented together with the appropriate question before proceeding to the next level of questioning and this continued until knowledge at all levels had been examined. Three knowledge levels (i.e., Levels III, IV and V) were assessed using two questions. At Level III, for half the faces the question "Is this person an educator?" was asked and for the remainder the question "Is this person a musician?" was asked. At Level IV the question "Is this person a primary school teacher?" was presented with the faces of educators and the question "Is this person a pianist?" was presented with those of musicians. Two types of question were used to assess knowledge about face-name associations. The first required a yes/no response and was included to maintain consistency with the format of questions asked at the previous levels. However, it was also possible for participants to base their responses to this question on familiarity with names rather than knowledge of face-name associations. This is because incorrect names would be sufficiently different from studied names to be classified as unfamiliar. For example, a person may decide that the name "Mary Lomas" is unfamiliar and on this basis judge that it is incorrect. In this case, the response is supported by high-level and not low-level knowledge. To address this problem, a two alternative forced choice question was included in which participants were required to choose between two studied names. Accurate responding to this question would require specific knowledge of face-name associations[2].

Results and Discussion

The yes/no recognition data is presented in Figure 7.4a for patients and Figure 7.4b for matched controls[3]. At each knowledge level, performance was assessed in terms of the difference between the proportion of hits (i.e., HR) and the proportion of false alarms (i.e., FAR). A dotted line has been added to each figure to indicate the point at which the score was significantly better than chance level. Fisher's exact test was used to evaluate yes/no recognition performance (i.e., Levels I to V). Performance on the two-alternative forced choice question (also at Level V) was evaluated using the chi-square goodness-of-fit test.

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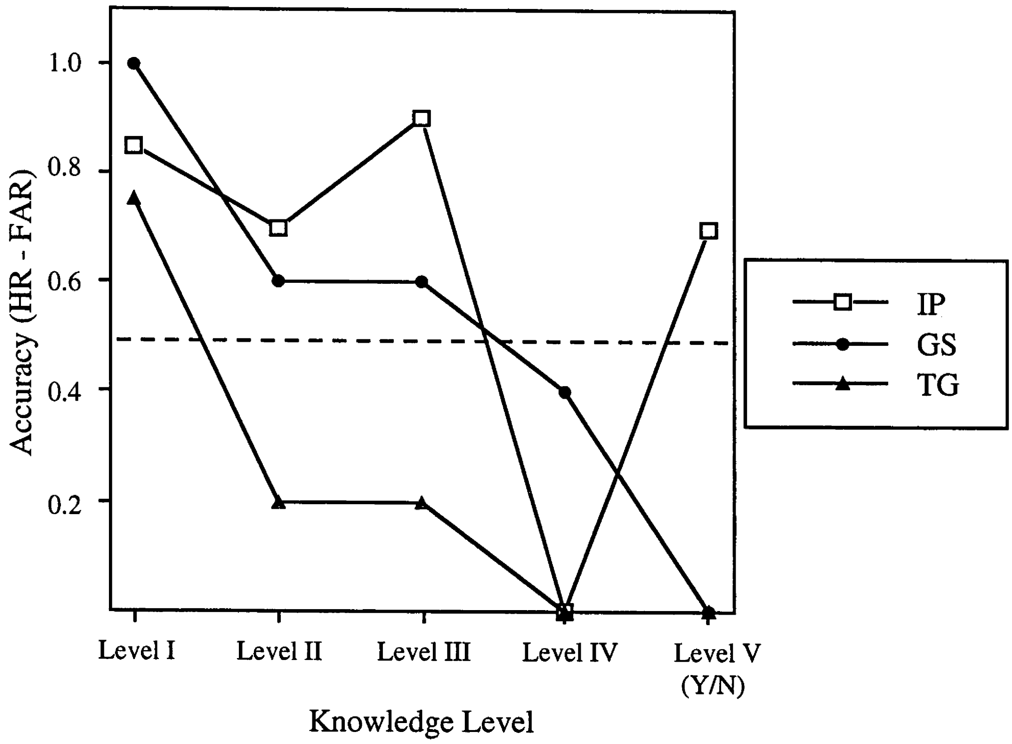
[2] The order in which experiments were conducted differs from that reported in this thesis. As a result there are differences in methodology between the current and previous studies — namely, in relation to the amount of study provided and the type of memory test (i.e., yes/no recognition versus forced-choice) employed.

[3] These figures differ from those presented in the previous chapter (i.e., bar graphs were used in the earlier experiments). This is because line graphs provide the best illustration of the declining trend in memory performance.

(a) Amnesic patients



(b) Matched Controls

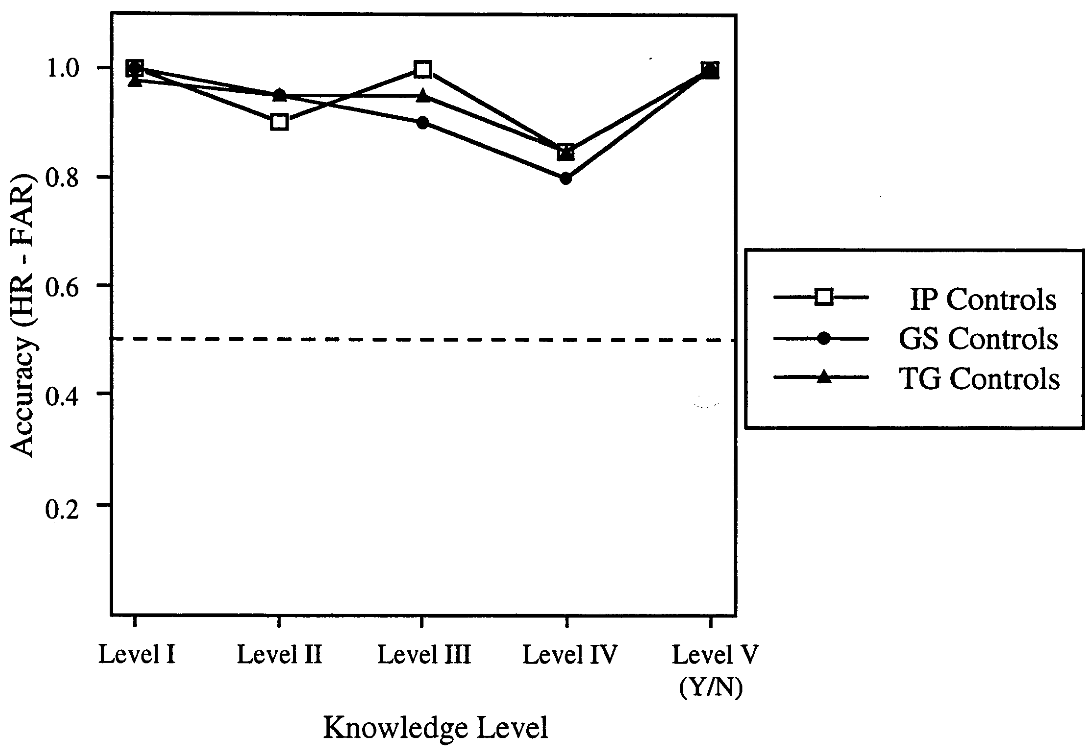


Figure 7.4 Accuracy (as a proportion of hits from false alarms) of yes/no recognition for novel faces as a function of level in (a) amnesic patients and (b) matched controls.

Figure 7.4a shows memory performance for the three patients at the five levels of knowledge examined with face cues. The three patients were significantly above chance in discriminating studied from non-studied faces at Level I (i.e., familiar versus novel, $p < .01$ in all cases), suggesting they were all familiar with the studied materials. However, from this point their memory performance differed. TG's performance was at chance at the remaining levels, indicating that she was unable to provide additional information explicitly beyond the most general level examined. IP and GS remembered more information as indicated by the accuracy of their responses at Levels II (i.e., entertainer versus non-entertainer) and III (i.e., educator or musician). Both patients could identify the faces of entertainers and could discriminate musicians from teachers ($p < .01$ for IP and $p < .05$ for GS at both levels). GS could not discriminate items at Levels IV (i.e., subtypes of educator and subtypes of musician) and V (i.e., names). IP's memory performance was also at chance at Level IV.

IP's results at Level V were unexpected. In the yes/no recognition test at Level his responses were significantly better than chance ($p < .01$), suggesting he had explicit access to knowledge about face-name associations even though he failed at Level IV. However, it is possible that this was not based on knowledge of face-name associations, but rather on mere familiarity with the studied names. As noted earlier, patients needed only to be familiar with the studied names to respond accurately to the question requiring a yes/no response at Level V. The forced-choice question at Level V addressed this problem. As expected, both TG and GS performed at chance when asked to identify which of two studied names matched a face, confirming that they had insufficient knowledge to make face-name associations. However, IP was still able to identify 18 names correctly in this forced choice test and this was significantly above chance ($\chi^2(1) = 11.25$, $p <$ .001). This result indicates that this patient had explicit knowledge of face-name associations despite performing poorly at the previous level requiring discrimination of subtypes of musician and subtypes of teacher. In short, TG was only capable of making familiarity judgements, while GS and IP provided additional semantic information down to the basic occupational category (i.e., Level III). IP could also discriminate faces at the most specific level examined (i.e., Level V), even though he was unsuccessful at the previous knowledge level.

To determine whether the breakdown in memory performance observed at the various levels was peculiar to amnesic patients, the same procedure was administered to a group of matched controls. The results for the two controls for each patient were averaged at each level. The means are shown in Figure 7.4b. The controls were accurate in discriminating faces at all levels examined. Their performance was significantly better than chance at Levels I to V in the tests requiring yes/no responses ($p < .01$ at all levels). In addition, they identified all names from the pair correctly ($\chi^2(1) = 18.05$, $p < .001$) at Level V. Thus, the controls could access the entire range of knowledge directly.

An interesting feature of the patient results is the difference between individuals in the amount of information accessible in response to direct questioning. TG was capable of making only the most general judgement, indicating "familiarity". Her responses to questions posed at Level I provide additional evidence of this inability to access semantic details about the studied people. Although participants were not asked to provide a rationale with their responses, TG did. In many cases she attributed a familiar face to an incorrect, but nonetheless logical, source (e.g., "I know this person. They must be the mother of a friend of my daughter's."). Both GS and IP were able to access semantic information about people beyond a judgement of familiarity. GS had sufficient knowledge to support discrimination down to the third level (i.e., involving the teacher/musician discrimination). Like GS, IP could not discriminate between subtypes of musician and subtypes of teacher (at Level IV), but was accurate in making face-profession associations at the more specific knowledge level.

IP was the only patient who performed above chance on both yes/no recognition and forced-choice at Level V, indicating he was able to acquire knowledge at the level of face-name associations. It is difficult to explain this result in light of his impaired performance at the previous knowledge level. If a name is to be considered as another very specific semantic fact about a person, this result is surprising. IP could not differentiate faces at the higher-level involving subtypes of musician and subtypes of teacher and the amount of specific knowledge required at Level IV would be less than that at Level V. There is an increased load on memory at Level V because knowledge about 20 individual names is required to support performance, whereas at Level IV knowledge about occupational subtypes only is required.

There is another way to conceptualise this. Although names were considered to lie at the base of the hierarchy of specificity used in the experimental design (see Figure 7.2), it can be argued that a person's name is *not* at the lowest level in such a hierarchy. In general, the classification of a low level entry in a semantic hierarchy is implied by its properties (e.g., knowing that someone is a violinist entails knowing that they are a musician and an entertainer). However, there are no properties intrinsically associated with a name. Each name could belong to any branch in the hierarchy. In this sense, a name should be seen as an arbitrary stimulus which has been associated during pairing with a branch of the semantic hierarchy in just the same way as a face was.

From this it might be suggested that in this experiment the patients were taught to associate two classes of physical cue, faces and names, with entries in the semantic hierarchy. The face-attribute tests at Levels I to IV examined face-meaning associations. Presumably, there were also name-meaning associations. The two tests at Level V did not examine these. Rather, they tested incidental associations between the face and name cues. It appeared that IP could form these face-name associations even though he could not form the most specific face-meaning association (i.e., at Level IV). The question that arises is whether he, and the other amnesic patients, could form name-meaning associations. This was examined in Experiment 5.

7.2 Experiment 5: Accessing higher-level knowledge directly from names

Results of Experiment 4 raised some questions concerning the inclusion of names at the lowest-level in a knowledge hierarchy. This issue was examined by evaluating the effectiveness of name cues in accessing information about people. Knowledge at Levels I to IV, used in the previous experiment, was examined with name cues.

If names represent the lowest level in a semantic hierarchy, then the two patients who failed at this level (i.e., TG and GS) should also be unable to provide any information about a person when names are presented as cues. These patients could not recover information at Level V, suggesting either that their knowledge was insufficient to support face-name associations or that they had acquired no information concerning the names themselves. An inability to recognize name-attribute associations at any level suggests that names might be appropriately placed at the most specific level in a hierarchy. Conversely, if patients can access information from names, then it suggests that they might have the same status as faces and thus should be excluded from such knowledge hierarchies. IP's performance is also important. Although he had acquired knowledge of face-name associations, it does not necessarily follow that he had associated names with other semantic attributes. If names are no different from other semantic attributes (and thus, have a different status to that of faces) then it is possible that IP could have acquired knowledge of face-name associations but not, for example, name-occupation associations.

In short, Experiment 5 had two aims. The first, was to determine whether patients could access any information about people from their names. If evidence of residual knowledge was found, the second aim was to determine whether the pattern of preserved and impaired performance displayed preservation of memory for generalities.

Method

Design

The design was similar to that employed in the test phase of Experiment 4. However, in the present experiment only the first four knowledge levels, used previously in Experiment 4, were examined (see Figure 7.2). The dependent measure was memory performance and this was determined by responses to yes/no recognition.

Participants

The people who took part in Experiment 4 also participated in Experiment 5.

Materials

The materials in this experiment consisted of a set of name cards which was used to cue knowledge about the people studied in Experiment 4. This set consisted of 40 names (first names and surnames), half of which were studied and the remainder non-studied. The non-studied names were constructed using the same procedure as that employed for studied names (see Appendix 2d for a list of these non-studied names).

Procedure

Experiment 5 was conducted after Experiment 4. For most participants a delay of about 10 minutes was provided between experiments. However, IP, whose performance prompted this experiment, was tested with name cues two days after his involvement in Experiment 4. No additional training was provided between the experiments.

The general procedure corresponded to that employed in the test phase of Experiment 4, but this time name cues were presented instead of face cues. Knowledge at four levels was assessed. These were identical to Levels I through IV in Experiment 4. As with faces, 40 name cues (comprising studied and non-studied names) were presented at Level I and 20 name cues (comprising studied names only) were presented at the remaining levels. All items relevant to Level I were presented before proceeding to Level II and so on until all knowledge levels had been examined.

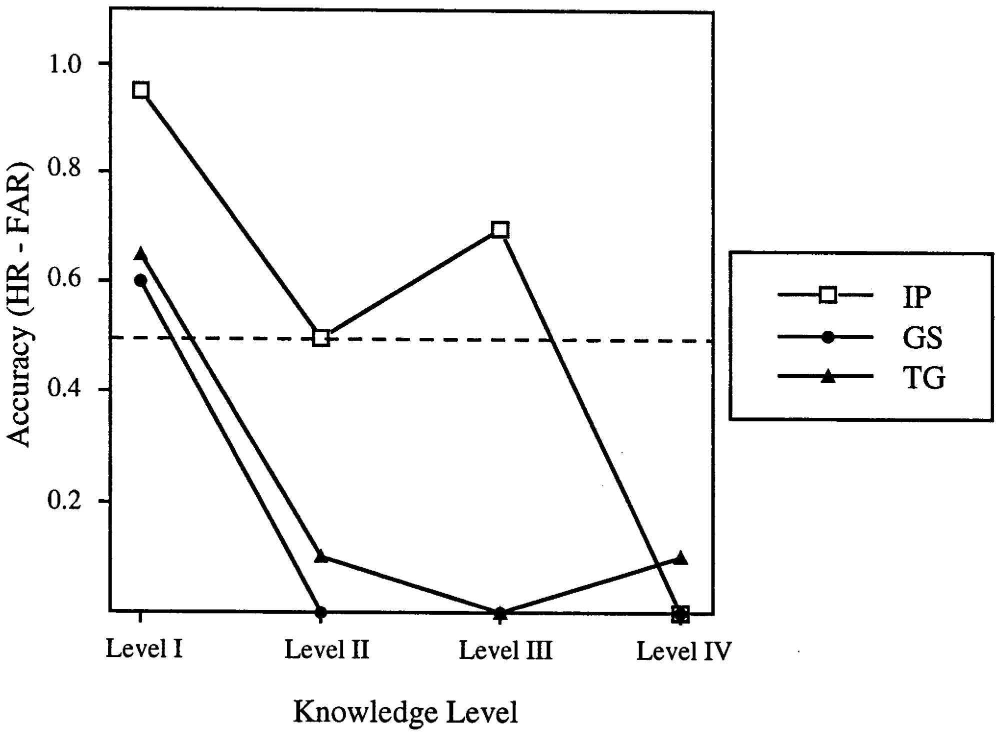
Results and Discussion

Results for name cues are presented in Figure 7.5a for patients and 7.5b for matched controls. In IP and TG the pattern of memory performance was generally consistent with that found with face cues. TG had sufficient knowledge to discriminate studied from non-studied names on the basis of familiarity only ($p < .03$). IP was capable of discriminating between names down to Level III. Thus, he judged old names as familiar ($p < .01$), could identify the names of entertainers ($p = .05$) and could discriminate the names of teachers from musicians ($p < .05$). This result is particularly striking in IP's case because of the greater delay imposed between study and test.

However, GS's performance with name cues was worse than that observed with face cues, even though the former were presented *after* the latter. While he could answer questions at Levels I to III in response to face cues, his performance with name cues was only significantly better than chance at the first level, familiarity ($p < .01$). Thus, it appeared that GS could associate intermediate levels of semantic detail with faces, but not with names.

GS's knowledge was examined again several days later but this time the order of cue presentation was reversed (i.e., name cues were followed by face cues). Additional study was not provided. There was no change in performance

(a) Amnesic patients



(b) Matched Controls

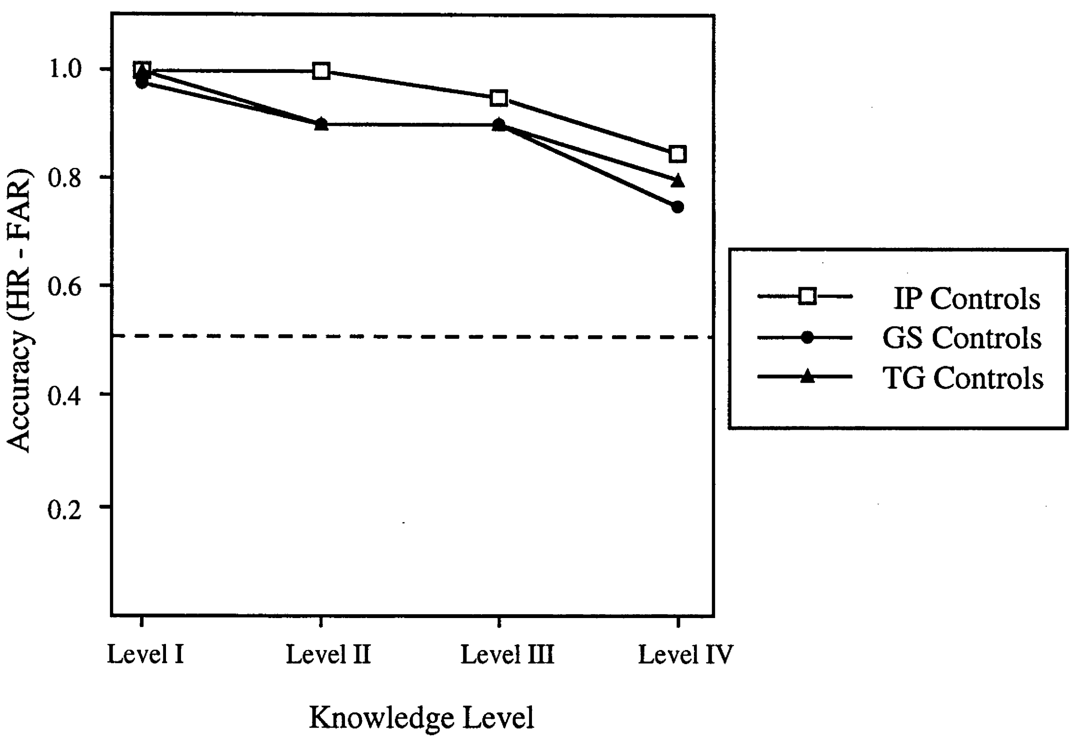


Figure 7.5 Accuracy (as a proportion of hits from false alarms) of yes/no recognition for novel names as a function of level in (a) amnesic patients and (b) matched controls.

with name cues. His responses were only better than chance at Level I ($p < .01$). However, memory performance with face cues deteriorated. He was only better than chance in discriminating faces on the basis of familiarity ($p < .01$). Thus, after a delay of several days no difference in performance with face and name cues was found and the knowledge available to GS was now only sufficient to support explicit discrimination of items at the most general level of knowledge examined.

Results from the matched controls are shown in Figure 7.5b. They were significantly better than chance in making familiarity judgements ($p < .01$ in all control pairs), identifying entertainers ($p < .01$ in all control pairs), discriminating teachers from musicians ($p < .01$ in all control pairs) and discriminating subtypes of teacher and subtypes of lecturer ($p < .01$ in controls matched to TG and IP, $p < .05$ in the pair of controls matched to GS). Thus, as with faces, controls were capable of accessing all information requested when cued with names.

Of these results, those from the patients are most pertinent to the aims of this experiment. The first aim concerned the relative position of names in a taxonomic hierarchy. It was suggested that an inability to access information about studied people from their names might support its placement at the lowest level of person-related knowledge hierarchies. However, responses from all three patients indicated that they could access some knowledge via names. TG and GS had sufficient knowledge to identify old names as familiar. IP could discriminate names down to Level III. Thus, while it was originally thought that names represented the most specific detail in a taxonomic hierarchy concerning people, these findings suggest that this is not the case. Patients were capable of forming name-attribute associations in addition to face-attribute associations. In fact, several patients (i.e., IP and TG) were capable of accessing the same amount of information from faces and names.

More important to the present thesis is whether the pattern of residual explicit knowledge in patients displayed preserved memory for generalities. IP's responses provide the clearest example of preserved memory for generalities. He acquired sufficient knowledge to respond accurately to questions posed at the first three levels and failed to discriminate names at the fourth level. Thus, he had shown that his knowledge at the more general levels was preserved and that at the most specific level was impaired. TG and GS, in making accurate judgements of familiarity, also demonstrated residual knowledge at the highest level examined. However, whether this can be interpreted as evidence of explicit memory for generalities is debatable and this issue will be discussed further in the concluding section of this chapter.

A final point relates to the differential performance observed between faces and names on initial testing with GS. When his knowledge was tested with face cues he had access to enough information to discriminate items at the first three levels. However, with name cues he could only discriminate studied from non-studied items (i.e., at Level I). This differentiation in memory performance suggests that GS had associated semantic information with faces but not with names. Given that face cues were presented before name cues, this result cannot be explained by priming. However, it might be explained by the increased salience of face cues. It could be argued that a face provides additional information (e.g., about attractiveness and age), and hence is more salient than a name. Accordingly, the information associated with face cues may have greater representational strength and thus, can be recalled more readily.

7.3 Conclusions from Experiments 4 and 5

In the previous experiments reported in Chapter 6, it appeared that amnesic patients could only demonstrate their knowledge of higher-level categorical relationships indirectly. The purpose of these experiments was to determine whether there was a level of "generality" at which amnesic patients could access knowledge explicitly. Results indicated that all patients could provide some information explicitly and that accuracy of responding tended to be greater at the more general knowledge levels, but worse than controls at all levels. There are several issues that arise from these findings and these involve: the evidence for direct access to higher-level knowledge, differences between patients in the accessibility of higher-level knowledge and comparison of the present results with those from a previous study in which higher-level knowledge was tested directly (i.e., Experiment 3).

The evidence for direct access to higher-level knowledge

In Experiments 4 and 5 results indicated that all three patients had acquired knowledge about novel people. In general, their residual memory was only sufficient to support performance at the higher levels of knowledge examined (IP's accuracy in face-name association was the only exception). All three patients were accurate in their judgement of familiarity with both cue types. IP could discriminate people down to Level III, again with both cue types, and GS could only achieve this level of discrimination with faces. Thus, the pattern of responding was generally characterized by preservation of memory for generalities.

The key issue though, was whether patients were capable of demonstrating their residual knowledge explicitly. Results indicate that two patients, IP and GS, accessed higher-level knowledge directly. Both responded accurately to questions down to the third knowledge level, though in GS this was only found with face cues. Thus, there is evidence from at least two patients to support the proposal that memory for generalities can be demonstrated explicitly when knowledge is examined at a sufficiently high-level of categorization.

There remains the question of how to interpret performance when memory is restricted to familiarity judgements. TG was only successful in making judgements of familiarity in response to both face and name cues. Similarly, GS was only accurate in judging familiarity with name cues. Is this performance based on implicit or explicit knowledge about studied people? It has been argued that familiarity judgements are based on some form of automatic response or an unconscious attribution which results from facilitation in processing of repeated items (Whittlesea, Jacoby & Girard, 1990; Whittlesea, 1993). Accordingly, accurate performance at Level I does not necessarily imply explicit access to knowledge. However, familiarity judgements can be explicit. There are situations in which *you know* a person is familiar, although you cannot access additional information about them. Such judgements are based on an explicit awareness of familiarity. This explicit judgement of familiarity is quite different from a correct guess (an "implicit" manifestation of familiarity) as the former is based on conscious knowledge.

TG's familiarity judgements were arguably of the explicit kind. This is indicated in the additional responses she provided at this level (i.e., stating that the person was known to her). TG's familiarity-based judgements were explicit because she *knew* the items were familiar. In this case, her memory was limited to an explicit feeling of familiarity — knowing that she knows a person without knowing why. The fact that she was inclined to justify her familiarity judgements could be seen as additional support for this argument. TG may have been compelled to justify her responses (at least to herself if not to the examiner) because she knew the person was familiar. Thus, there is a case for interpreting familiarity as an explicit expression of knowledge. If one accepts this, then TG's performance can also be interpreted as evidence of explicit memory for generalities.

Differences between patients in access to knowledge

The amount of information that the patients could provide in response to direct questioning varied. IP provided the most information followed by GS and then TG. Variation in severity of memory impairment is perhaps the most plausible explanation. It is possible that this affected the specificity of knowledge stored or how much information could be accessed explicitly. Either of these explanations could account for differences between patients and also within patients (i.e., the differentiation in GS's performance with faces and names).

Comparison of results from Experiments 3, 4 and 5

Results from Experiments 4 and 5 can be compared with those from Experiment 3. In Experiment 3, direct access to higher-level knowledge was also examined. Only two patients, IP and TG, participated in that experiment and both failed to access information at the levels of educator/tradesperson and teacher/lecturer in response to direct questioning. The failure by IP at the level of educator/tradesperson in Experiment 3 is inconsistent with his performance in the current experiments, where he was accurate in discriminating teachers from musicians. It may be that the educator/tradesperson and teacher/musician discriminations are not of equivalent difficulty, but it is also possible that IP accessed more information directly here than in the previous experiment. This could be a consequence of additional training provided in the present experiment (i.e., 4 days of training compared with one session in Experiment 3) which may have facilitated his memory performance, perhaps by increasing the strength of associations. In contrast, TG's memory performance in these experiments was consistent. The information she accessed in the present experiment (i.e., familiarity only) was more general than that represented at the level of educator/tradesperson.

In summary, results of Experiments 4 and 5 provide evidence of direct access to higher-level knowledge in all patients, and this confirms that preservation of memory for generalities is not simply a consequence of testing conditions. This was demonstrated most clearly in the performance of two patients, IP and GS, and the extent to which TG's memory performance reflected explicit knowledge might be debated. In addition, the results provide further evidence of preservation of memory for generalities. Accuracy of responses was greater at the more general knowledge levels.

Chapter 8

Preservation of memory for generalities in retrograde amnesia

The experiments reported in the previous chapters provide evidence of preserved memory for generalities in a condition other than dementia, namely anterograde amnesia. Chapter 6 reported evidence of preserved memory for generalities when higher-level knowledge was tested indirectly. Experiments 4 and 5 indicated that patients could also access some higher-level knowledge directly, but that this was limited to the most general levels examined. All of these studies investigated the generalities phenomenon with respect to new learning. While there are similarities between patients suffering from amnesia and dementia in relation to the generalities phenomenon, there is also an important difference. In the case of amnesia the observed preservation of memory for generalities was manifested in relation to material acquired *after* the onset of the memory disturbance, whereas the deficiency reported in dementia concerns knowledge acquired *before* the onset of the condition.

Retrograde amnesia, like dementia, affects knowledge acquired prior to the onset of the condition. As in anterograde amnesia, the memory loss in retrograde amnesia (RA) is not total, and it was considered possible that the pattern of preserved and impaired ability in this form of amnesia might also show a differentiation between high- and low-level knowledge. If preservation of memory for generalities occurred in dementia and both forms of amnesia, then this would suggest that the phenomenon has wide application — it may be characteristic of deficient memory in general and not simply of particular clinical conditions. It was seen in Chapter 3 that several findings could be interpreted as evidence of preserved higher-level knowledge in RA. However, the evidence is scant and the studies concerned did not focus primarily on this issue. These shortcomings are addressed in the present chapter.

The aim of the present series of experiments was to test for the existence of the generalities phenomenon in retrograde amnesia using the direct and indirect testing techniques described in previous chapters. As in the previous studies, knowledge about people was investigated using face and name cues to elicit the information. However, in the present experiments, pre-existing knowledge about face-name associations was examined. The question of preserved memory for generalities in RA was explored in two knowledge domains — autobiographical and public. When tested directly TG, one of the three patients participating in the present series of experiments, remembered higher-level information better than lower-level detail in both autobiographical and public knowledge domains (i.e., in Experiments 6 and 8 respectively). Interestingly, in both experiments, more information was accessible in response to names. The influence of indirect testing procedures was examined in the autobiographical domain only. When TG's knowledge was tested indirectly in the autobiographical domain (i.e, in Experiment 7) it was found that she could access information that had previously been unavailable with direct testing[4].

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[4] In previous chapters, results of indirect tests are reported before results of direct tests. This order of reporting is reversed in the present chapter. This is because the levels used in examining autobiographical memory for generalities indirectly was contingent on results of the experiment examining autobiographical memory for generalities directly.

8.1 Investigation of autobiographical memory for generalities

8.1.1 Experiment 6: Direct examination of autobiographical knowledge

Preservation of autobiographical memory for generalities was investigated in the one patient who suffered from RA (i.e., TG). As in Experiments 4 and 5, knowledge across a range of levels (see Figure 8.1) was examined by asking a series of direct questions. These questions were used to elicit information about people known personally to TG. They ranged from the very general to the very specific, and were presented with both face and name cues.

The aim was to determine whether TG's residual autobiographical knowledge would display the generalities phenomenon. Her responses on the

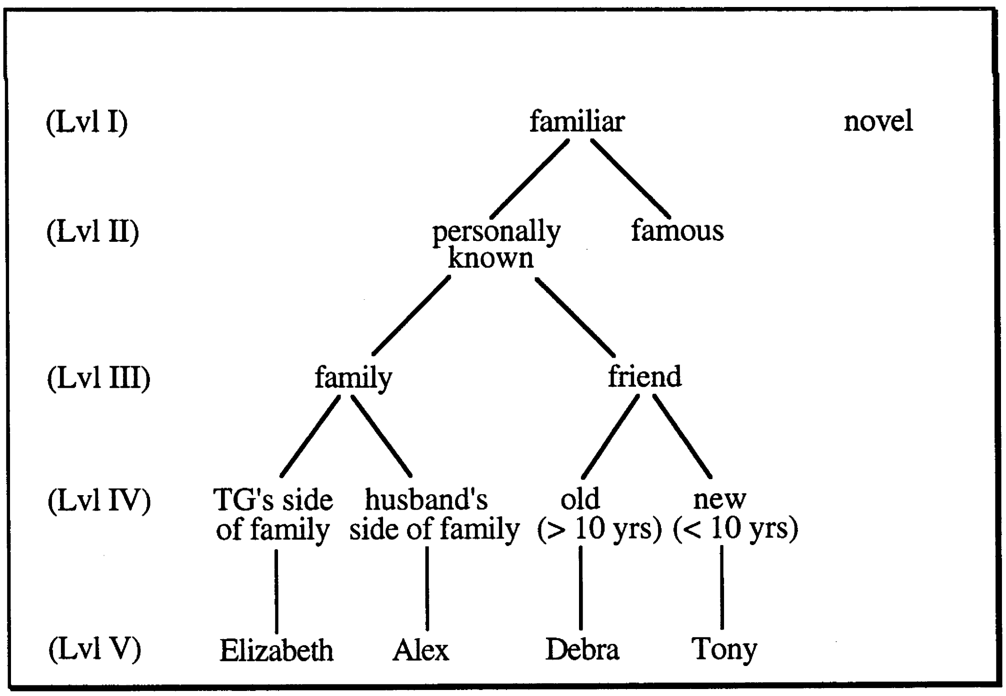

Figure 8.1 The hierarchy of knowledge levels used in Experiment 6

Autobiographical Memory Interview (see Chapter 5) indicated that her memory for this information was not completely lost. This experiment was intended to determine whether this memory was better for general-level information than for specific detail.

Method

Design

The design was similar to that employed in Experiments 4 and 5 (see Figure 8.2). The two independent variables were cue type and knowledge level. There were two cue types, faces and names. As previously, five knowledge levels were examined with face cues but only four were examined with name cues. The dependent measure was memory performance and this was determined on the basis of responses to yes/no recognition.

		Cue	
		Faces	Names
Level	I: Familiarity (family/friend vs novel)	N = 40 (20 f/f, 20 novel)	N = 40 (20 f/f, 20 novel)
	II: General relationship (family/friend vs famous)	N = 40 (20 f/f, 20 famous)	N = 40 (20 f/f, 20 famous)
	III: Basic relationship (family vs friend)	N = 20 (10 family, 10 friend)	N = 20 (10 family, 10 friend)
	IV: Specific relationship (X's child vs other's child or old vs new friend / TG's vs husband's side of family)	N = 12 (3 X's, 3 other, 3 TG's, 3 husband's)	N = 26 (9 old, 9 new, 4 TG's, 4 husband's)
	V: Name	N = 20 (10 family,10 friends)	

Figure 8.2 Design of Experiment 6

Participants

One patient with retrograde amnesia, TG, took part in this study.

Materials

Two sets materials were used — one set of face cards and one set of name cards.

The set of face cards consisted of 66 faces. There were two categories of faces. One category consisted of faces that were familiar to TG (N = 46) and the other consisted of novel or unknown faces (N =20). The familiar faces comprised: family members (N = 10), friends (N = 10), friends' children (N = 6) and famous people (N = 20). Pictures of people were either collected from magazines or supplied by TG's husband. Both famous and unknown faces were matched as closely as possible to those of family members and friends on the basis of age, sex and attractiveness. A list of the famous people used in this experiment is provided in Appendix 3a. They consisted of television, movie, sporting and royal personalities. The pictures/photographs were scanned into a computer and were reproduced using the same procedure discussed in previous experiments. They were printed in black and white, had a neutral background and were 5 cm in width and 6 to 7 cm in height (see Appendix 3b for examples of famous faces). Although these dimensions are smaller than those used in previous experiments, there was no reduction in the clarity of faces associated with this modification in size.

The name cue cards consisted of 68 names (first name and surname pairs) and these belonged to familiar (N = 48) and novel (N = 20) people. The familiar names comprised: family members (N = 10), friends (N =18) and famous people (N = 20, also used with face cues). Each of these names were matched to those of family members and friends on the basis of sex and syllable length (e.g., if the first name of a family member had two syllables then the novel first name also had two syllables). In addition, several of the novel surnames were repeated as there were family members and friends who shared the same surname. The novel names are listed in Appendix 3c.

Procedure

There were two phases. In the first phase knowledge about people was examined using name cues and in the second phase knowledge was examined using face cues. This order was the reverse of that used in previous experiments (i.e, in Experiments 4 and 5) where a difference was found in the amount of information recalled with face and name cues. This was done to maintain motivation levels, assuming that the same pattern of differential performance would occur.

Although the general procedure was similar to that employed in Experiments 4 and 5, there were some added complications because of the individualized nature of the stimulus set. The number of items presented at each level varied as did the category of person (i.e., family member, friend, famous and unknown) presented for discrimination at these levels. In addition, at Level IV, the questions presented with face cues differed from those presented with name cues at one level). This was because photographs of relevant friends were not available and thus a different question was required to test knowledge about people. These complications are addressed in discussion of the relevant phases below.

Four levels of knowledge were examined with name cues. The materials used to test knowledge at these levels were selected and prepared with the assistance of TG's husband. Names of people with the same surname and maiden name as TG were not included because judgements involving these names could be made on the basis of familiarity rather than on the basis of knowledge about the particular person in question. If the surname was the same as TG's, then she may have decided that the person is related to her without knowing anything about them. Questions were presented with each cue and these tapped a range of details from general to increasingly more specific. Specificity was determined on the basis of the amount of detailed knowledge required to answer the questions. The category of name cue (i.e., whether the person was family, friend, famous or unknown) presented at each level differed. The questions asked at each level were as follows:

Level I: "Is this person familiar?"

Level II: "Is this person a family member/friend?"

Level III: "Is this person family?"

Level IV: "Is this person from (husband's) side of family?"
"Is this an old (> 10 yrs) friend?"

At the first level, TG was asked to make a judgement of *familiarity*. At Level II, knowledge of general relationships was examined by asking TG to discriminate *personally familiar from famous people*. The discrimination at Level III, tested knowledge of basic relationships, and this involved differentiating *family members from friends*. At Level IV, specific knowledge about family relationships and friendships was examined. Knowledge of family relationships was examined by asking TG to discriminate between names belonging to people *from her side and her husband's side of the family*. In the case of friendships, she was asked to discriminate *old friends from new*. As in earlier experiments, all items at Level I were presented before proceeding to Level II and so on until knowledge at all levels had been examined.

After a short break (i.e., about 10 mins.) knowledge was tested with face cues. This time knowledge was examined at five levels. The questions at each level were as follows:

Level I: "Is this person familiar?"

Level II: "Is this person a family member/friend?"

Level III: "Is this person family?"

Level IV: "Is this person from (husband's) side of family?"
"Is this (X's) child?"

Level V: "Is this person's name _______?"

The questions asked about people at Levels I to III with name cues were the same as those presented with face cues. However, at Level IV, a change in procedure was introduced to address the problem of insufficient materials. The number of items presented with the family relationship question was reduced and this represented only a minor modification. The most significant modification involved a change in the items and question presented to test knowledge of friendships. To test knowledge of specific friendships TG was asked to discriminate *children* on the basis of whether they belonged to a *particular friend* (i.e., X) *or other friends*. To answer this question correctly TG would need to have knowledge of the parent-child relationships of her friends. Thus, although the question was not the same as that used with name cues, it nevertheless probed specific knowledge about friends. A final question was asked to elicit knowledge of face-name associations for family members and friends. Given the difficulties experienced with this level in previous experiments (namely, Experiments 4 and 5) it was decided that only correct names would be included. Half were correctly paired with faces and half were incorrectly paired.

Results and Discussion

Accuracy of memory performance at each level with the two cue types is shown in Figure 8.3. As in the previous studies, accuracy was determined by subtracting the proportion of false alarms from the proportion of hits and, the dotted line shows the level of accuracy required for above chance performance. Performance was evaluated statistically using Fisher's exact test.

TG responded accurately to questions posed at all levels with name cues. Thus, she was significantly better than chance in discriminating known from unknown names ($p < .01$), personally familiar from famous names ($p < .01$), and the names of family members from friends ($p < .01$). Responses to the two questions at Level IV were combined and results indicated that TG could identify the names of people from her husband's side of the family and the names of old friends ($p < .01$). Errors at the latter level were only made in response to questions eliciting knowledge about friends. Thus, TG's performance with name cues indicated that she had access to a range of knowledge about people known to her personally.

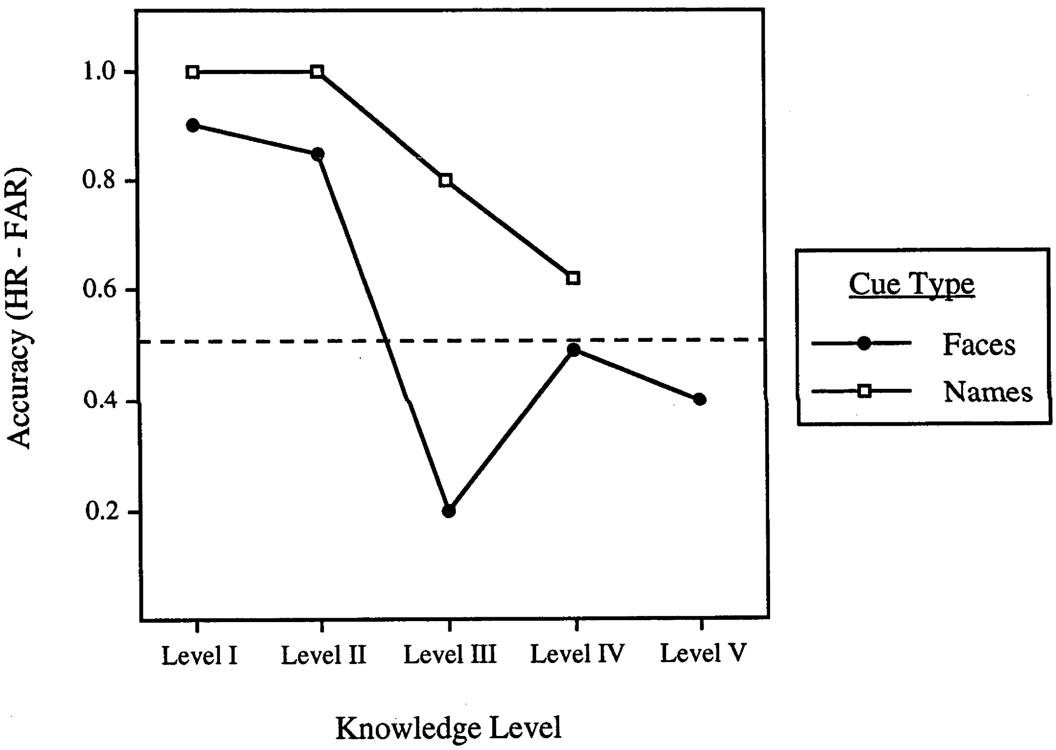

Figure 8.3 Accuracy (as a proportion of hits - false alarms) of TG's autobiographical memory in response to face and name cues.

In contrast, performance with face cues was poor. TG was only accurate in discriminating faces at the first two levels. That is, she was significantly better than chance in discriminating known from unknown faces ($p < .01$) and personally familiar from famous faces ($p < .01$). However, her performance with face cues broke down at Level III and this result can be directly compared with that for name cues. Knowledge about the same people was examined at Level III with name cues, and TG's performance in this case was significantly better than chance. This indicates that information available in one modality was not available in another. Performance at the remaining levels, examining knowledge about specific family relationships and friendships as well as face-name associations, was also no better than chance. This pattern of performance again shows preservation of memory for generalities, this time in the domain of autobiographical memory. TG's knowledge for more general information about people known to her personally was preserved and that for more specific details was impaired. This confirms that memory for generalities can occur in amnesics with deficits to new learning as well as pre-existing knowledge.

The difference in performance with face and name cues was unexpected. TG accessed more information from names than she did with faces. This pattern is the reverse of what might be expected if the salience of clues is considered (see Discussion in Chapter 7). Faces contain semantic information about a person that is not present in names (e.g., about attractiveness, age, etc), and on this basis it could be argued that the former might be a more effective cue. Accordingly, memory that is cued with faces should be better than that cued with names. However, TG's performance is not consistent with this analysis, and she is not the only patient with retrograde amnesia who has shown such a differentiation (see RFR's performance in Experiment II reported by McCarthy & Warrington, 1992). The difference between faces and names, while not central to theories of amnesia, is relevant to theories of face recognition. In particular, differences in the amount of information accessible via faces and names challenge theories that propose a unitary semantic information store. These theories will be discussed in Chapter 10, where a theoretical analysis of findings is undertaken. The implications of TG's differential memory performance with faces and names will also be considered.

8.1.2 Experiment 7: Indirect examination of autobiographical knowledge

Given TG's failure to provide specific details about people in response to direct questioning in the previous experiment, it was of interest to determine whether she could access any of this information *indirectly.* In the experiments reported in Chapter 6, it was found that indirect tests were more effective than direct ones in accessing higher-level knowledge. It was therefore considered possible that at least some of the autobiographical information TG could not access directly with face cues might be retrievable under indirect testing conditions.

In Experiment 6 TG's responses to faces was no better than chance from the third level, involving examination of basic relationships (i.e., involving discrimination of family members from friends). The aim of the present experiment was to determine whether TG could access this information when knowledge was tested indirectly. Adopting the methodology used in Chapter 6, TG was asked to discriminate between two types of family member (i.e., her side versus her husband's side of the family) and two types of friend (i.e., old versus new). Her errors in this discrimination task would provide an indirect measure of her ability to discriminate at the higher categorical level involving family and friends — a level at which she failed in the previous experiment. The two levels, general and specific, involved in this experiment are illustrated in Figure 8.4.

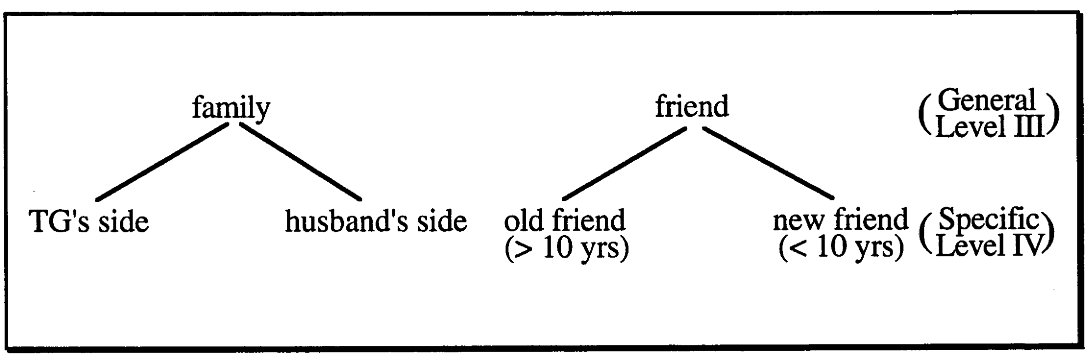

Figure 8.4 Knowledge levels used in Experiment 7.

Method

Participants

TG was the only participant in this experiment.

Materials

The materials consisted of 28 faces and a sheet listing four categories of people known personally to TG.

The faces consisted of people from TG's side of the family ($\underline{N}$ = 7), her husband's side of the family ($\underline{N}$ = 7), old friends (i.e., known for more than 10 years, $\underline{N}$ = 7) and new friends (i.e., known for less than 10 years, $\underline{N}$ = 7). These faces were scanned from photographs collected by TG's husband. They were reproduced using the same procedure as was employed in the previous experiment. This set of faces contained additional items that were not presented in Experiment 6. This is because they were not available at the time that Experiment 6 was conducted.

The four categories consisting of TG's side of the family, her husband's side of the family, old friends (> 10 years) and new friends (< 10 years) were listed in order on a separate sheet for TG to use when making her judgements.

Procedure

TG was told that she would see a series of faces and that her task was to identify them according to whether they were from her side of the family, her husband's side of the family, an old friend or a new friend. She was encouraged to provide a response for every face even though it might be based on a guess. The faces were then shown individually, in a random order, and her responses were recorded.

Results and Discussion

TG's responses are divided into three categories. They were either correct, semantically-related (e.g., nominating the category "old friend" when the correct category was "new friend") or unrelated (e.g., choosing "old friend" when the correct response was "TG's side of the family") to the target. The frequency of these responses is shown in Figure 8.5. The top panel shows TG's performance on within-category discrimination (i.e., ability to make specific judgements) and the bottom shows performance on between-category discrimination (i.e., ability to make general judgements).

As the top panel of Figure 8.5 shows, the frequency of correct responses was only marginally greater than semantically-related errors. This difference was not significant. Thus, TG was no better than chance in making the specific discrimination involving subtypes of family member and subtypes of friend. In contrast, the frequency of correct category responses was significantly greater than unrelated responses ($\chi^2(1) = 22.3$, $p<.001$), indicating that TG could discriminate faces at the higher-level of family/friend. This was a discrimination that she failed to make in the previous experiment when knowledge at the same level was tested directly. Closer inspection of correct category responses revealed that TG made twice as many confusions with the faces of friends. This may reflect the greater representational strength of memories associated with family, resulting in fewer confusions with this category of person. Such an imbalance was not found in similar experiments (i.e., Experiments 1 and 2) investigating the generalities phenomenon with respect to new learning. However, in the latter studies no difference in the representational strength of newly acquired associations would be expected.

In sum, results of this experiment confirm that indirect tests reveal knowledge that is not available in direct tests. While in previous experiments the effect of indirect testing was demonstrated in new learning, the present findings show that the same effect also occurs with pre-existing knowledge.

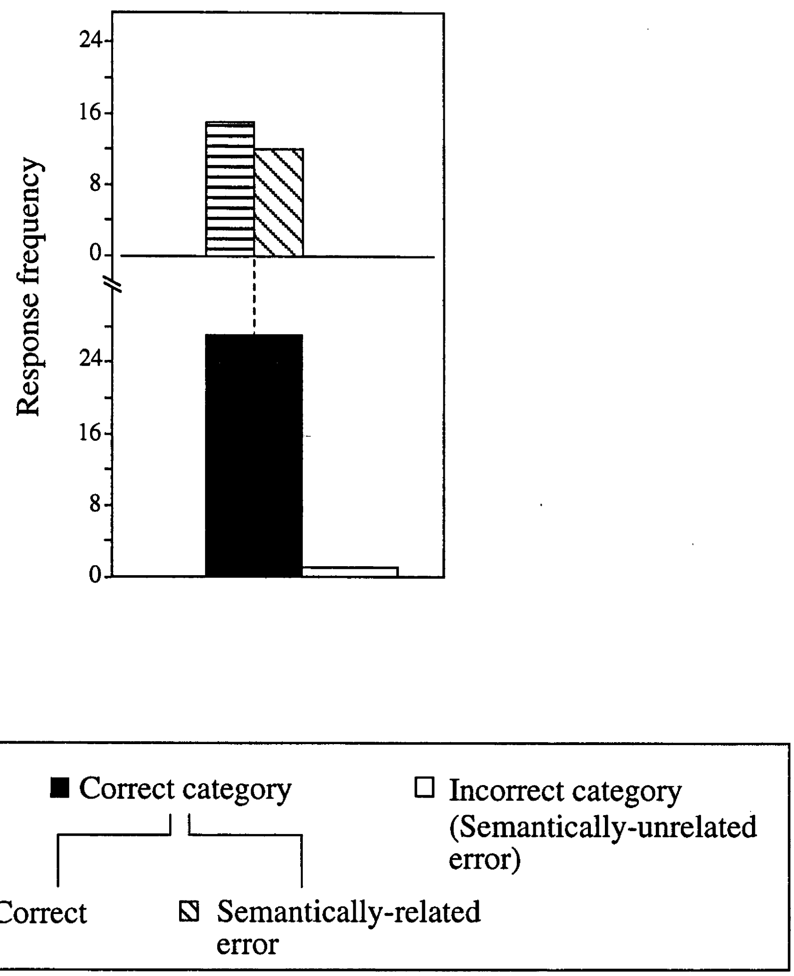

Figure 8.5 Results of indirect testing of higher-level autobiographical knowledge in TG.

8.2 Investigation of memory for generalities in the public domain

8.2.1 Experiment 8: Direct examination of memory for famous people

Results of Experiment 6 showed that a patient with RA could explicitly remember higher-level information about familiar people at least from their faces. That experiment investigated knowledge in the autobiographical domain. However, remote memory also contains information relating to the public domain and it is considered of interest to see whether the same patient would display the preservation of memory for generalities phenomenon in this other knowledge domain.

Remote memory in the public domain was investigated in the three patients, two of whom had participated in earlier experiments. Two patients suffered from the anterograde form of amnesia only and one patient suffered from both forms of the disturbance. The performance of the latter patient, TG, was of particular interest. The other patients were included as additional control subjects and to check their status as anterograde amnesics. The aim was to determine whether TG could access any remote public knowledge directly and, if so, to determine whether her responses revealed preservation of memory for generalities. Knowledge about famous people was examined using the general procedure employed in Experiments 4 and 5. Again, a series of direct questions were asked to probe knowledge for a range of details, from general to specific, about these people (see Figure 8.6). Both faces and names were used to cue knowledge. It was anticipated that of the three patients only TG would demonstrate any impairment in remote memory function in accordance with their neuropsychological classification. TG's remote memory loss could either be complete or partial. A pattern of partial memory loss together with accurate responses to questions tapping general information only, would be consistent with preservation of remote memory for generalities.

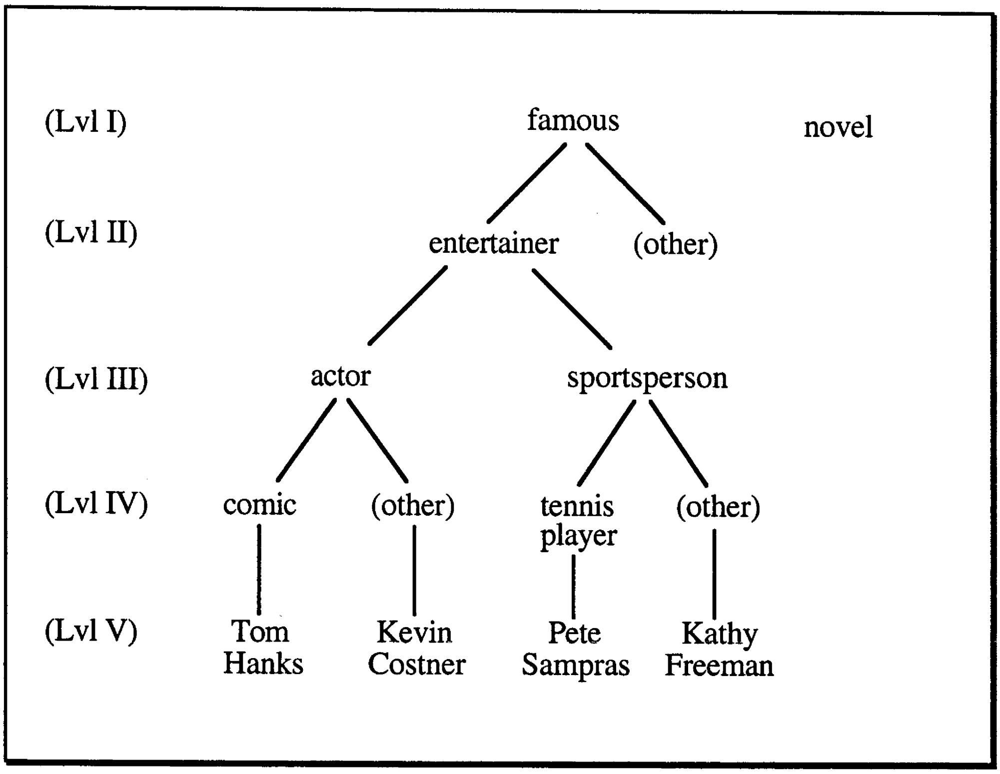

Figure 8.6 The hierarchy of knowledge levels used in Experiment 8.

Method

Design

The independent variables were cue type and knowledge level, both of which were manipulated within subjects. Cue type had two levels, faces and names. Five knowledge levels were examined with faces. These comprised: fame status, general occupational category (entertainer/not entertainer), basic occupational category (actor/sportsperson), specific occupational category (subtype of actor and subtype of sportsperson) and name. Knowledge at the first four levels was also examined using name cues. The dependent measure was memory performance, determined on the basis of responses to yes/no recognition (with both types of cue) and two alternative forced-choice (with faces only)[5]. The design is shown in Figure 8.7.

		Cue	
		Faces	Names
	I: Fame (famous vs novel)	N = 40 (20 famous,20 novel)	N = 40 (20 famous,20 novel)
	II: General occupational category (entertainer vs non-entertainer)	N = 20 (10 actors, 10 sports)	N = 20 (10 actors, 10 sports)
Level	III: Basic occupational category (actor / sportsperson)	N = 20 (10 actors, 10 sports)	N = 20 (10 actors, 10 sports)
	IV: Specific occupational category (comic actor / tennis player)	N = 20 (10 actors, 10 sports)	N = 20 (10 actors, 10 sports)
	V: Name	N = 20 (10 actors, 10 sports)	

Figure 8.7 Design of Experiment 8

Participants

Nine people participated in this study — three amnesic patients (i.e., TG, GS and IP) and six matched controls. These controls were the same as those who had participated in Experiments 4 and 5.

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[5] This study was conducted prior to Experiment 6 and concurrent with Experiments 4 and 5. Thus, while examination of knowledge with faces at Level V (i.e., name) in the present study differs from that in Experiment 6, it parallels that of Experiments 4 and 5.

Materials

The materials consisted of a set of face cue cards and two sets of name cards. The face cues comprised 40 faces, half of which were famous and the other non-famous. The famous people comprised 10 actors and 10 sportspeople. In each category, half were male. The names of the famous people are listed in Appendix 3d. They were selected on the basis of being currently famous and salient to an Australian population. They were initially chosen on the basis of responses to a pilot survey requesting the names of famous individuals (N = 10) and were subsequently identified as highly recognizable by a small group of first year psychology students (N = 9, mean age = 21 years, SD = 2.1). Salient famous people were selected to maximize the probability that they were known to patients prior to the onset of amnesia. The pictures did not contain any features that would provide clues about the occupation of the subject. They were scanned into a computer and reproduced in exactly the same manner as described in the previous experiments (see Appendix 3e for examples of these faces). The 20 non-famous faces were collected from advertisements in magazines. They were matched to the famous people as closely as possible in terms of age, sex and attractiveness and were also scanned and reproduced using the procedure outlined in earlier experiments (see Appendix 3f for examples).

There were two sets of name cards. One set was used to test knowledge about famous people. This set consisted of 40 names. Half of these names were those of famous people and the remainder were unknown. The latter names were constructed according to the procedure outlined in Experiment 5 and are listed in Appendix 3g. The second set was used with face cues to examine knowledge of face-name associations and there were two types of cards as illustrated in Figure 8.8. One type contained a single name (see Figure 8.8a) and the other type contained a pair of names (see Figure 8.8b). Half of the single name cards contained correct names and the remainder were incorrect. As in Experiment 7, the incorrect names were produced by changing the second syllable of the surname (e.g., "Mel Gibson" was changed to "Mel Gibbons", see Appendix 3h). The name pair cards contained two famous names from the same gender and basic occupational category. On half of the trials the correct name was the first item in the name pair and on the remaining trials it was the second item.

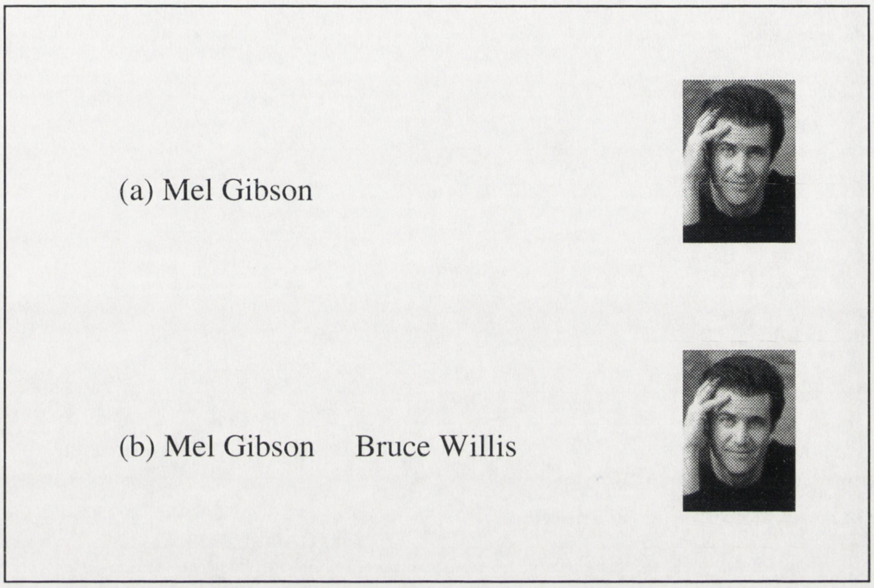


Figure 8.8 The two types of name cards used to test knowledge for face-name associations (a) single name card and (b) name pair card.

Procedure

The general procedure employed in this experiment was similar to that used in the test phase of Experiments 4 and 5. Knowledge was tested in two ways — using face cues and name cues. In the case of patients, knowledge was examined first with face cues and then with name cues. The order of cue presentation was counterbalanced across the two controls matched to each patient. A short break of 10 minutes was provided between the two phases of testing.

Five knowledge levels were examined with face cues and knowledge at each level was elicited by asking questions. The questions ranged from the very general to the very specific. As in the earlier experiment, specificity was determined by the number of people who shared the attribute in question. The attribute was shared by 20 people at the most general knowledge level, and this number decreased progressively as the questions became more specific. The questions presented at each level were as follows:

Level I:	"Is this person famous?"
Level II:	"Is this person primarily in the entertainment industry?"
Level III:	"Is this person an actor?" or "Is this person a sportsperson?"
Level IV:	"Is this person a comic actor (i.e., appeared in comedy)?" or "Is this person a tennis player?"
Level V:	"Is this person's name _______?" "Is this person's name _______ or _______?"

Knowledge at Levels I to V was assessed progressively, in descending order. The entire set of 40 face cues (both famous and non-famous) were presented individually and randomly at Level I. From this level onwards only the famous faces were presented. At three knowledge levels (i.e., Levels III, IV and V) one of two questions were presented with faces. For half of the items at Level III participants were asked whether the face was that of an actor and for the remainder whether the face was that of a sportsperson. At Level IV, participants were asked to judge whether actors were comic actors and whether sportspeople were tennis players. Knowledge of face-name associations was examined in two ways at Level V. First, a yes/no response was required for all items at Level V (see Figure 8.8a). These items were then presented a second time, but here participants were required to choose between two names (see Figure 8.8b).

Knowledge at the first four levels was re-examined with name cues using the same questions. As was the case for faces, 40 name cues were presented at

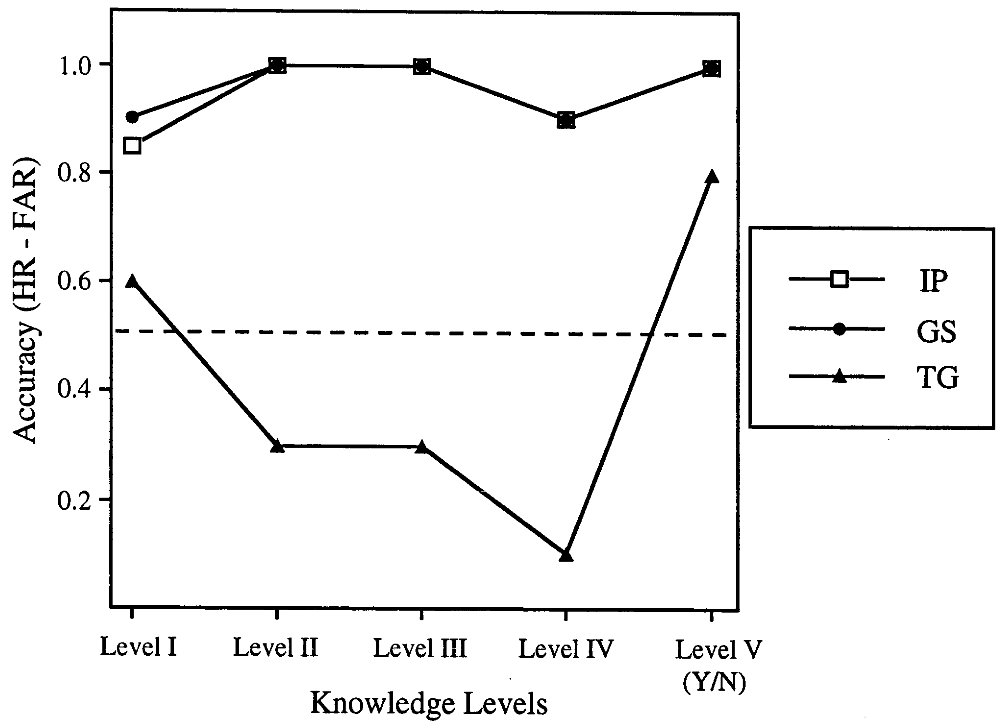
Level I and 20 name cues were presented at the remaining levels. All Level I items were presented before proceeding to Level II and so on until knowledge at the four levels had been examined.

Results and Discussion

Faces

The face cue data are presented in Figure 8.9a for the patients and Figure 8.9b for the controls. As predicted, TG (the only retrograde amnesic) was the only patient who had difficulty answering questions associated with famous faces. She was significantly better than chance in discriminating famous from non-famous faces ($p < .05$), but her performance declined at the next three levels. Thus, she had insufficient knowledge about famous people to discriminate entertainers from non-entertainers, actors from sportspeople and subtypes of actor as well as subtypes of sportsperson. There was some inconsistency in her responses at Level V. While responses to the yes/no question were generally accurate ($p < .01$), those to the forced choice question were no better than chance. As discussed earlier in Experiment 4, the latter result suggests that in the case of the former question performance was not based on knowledge of particular face-name associations, but rather on familiarity. Modified names were not familiar and accordingly could not belong to famous people. Overall, TG's results indicate that she was capable of accessing some knowledge directly about famous people when cued with faces, but that this was restricted to the most general level examined. In contrast, the remaining patients (IP and GS) and matched controls were significantly better than chance in their responses to yes/no questions at Levels I to V ($p < .01$ at all levels) and were also accurate in their forced choice judgements at Level V ($\chi^2(1) = 18.05$, $p < .001$).

(a) Amnesic patients



(b) Matched controls

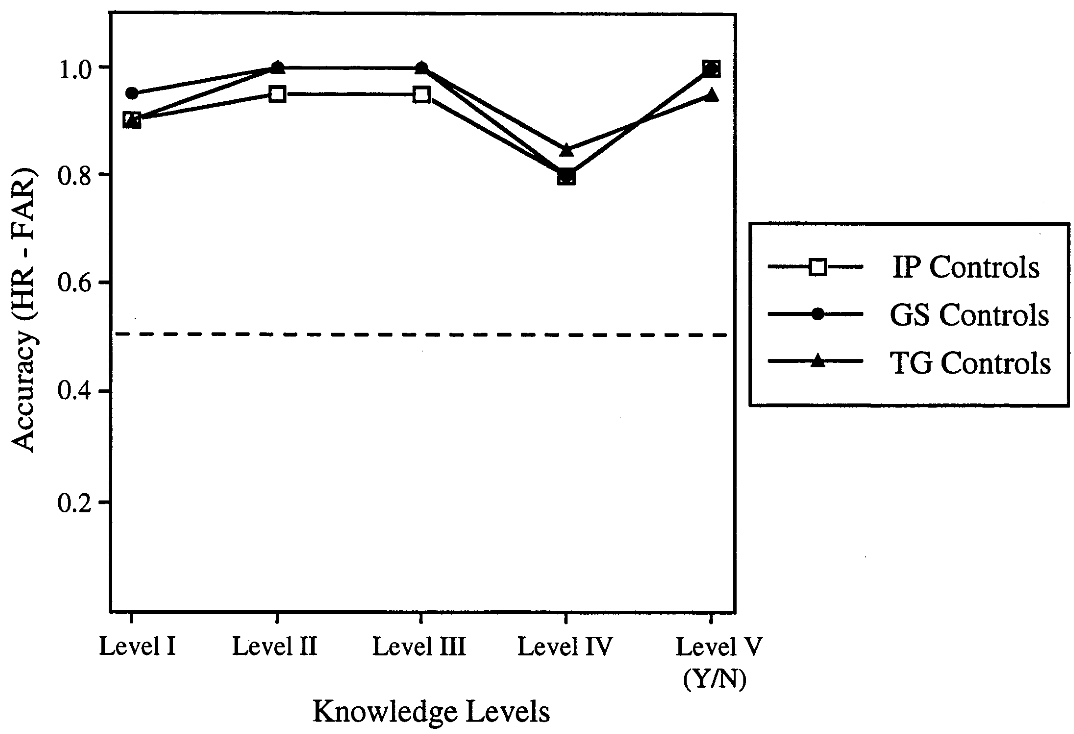


Figure 8.9 Accuracy (as a proportion of hits - false alarms) of yes/no recognition for famous faces as a function of level in (a) amnesic patients and (b) matched controls.

Names

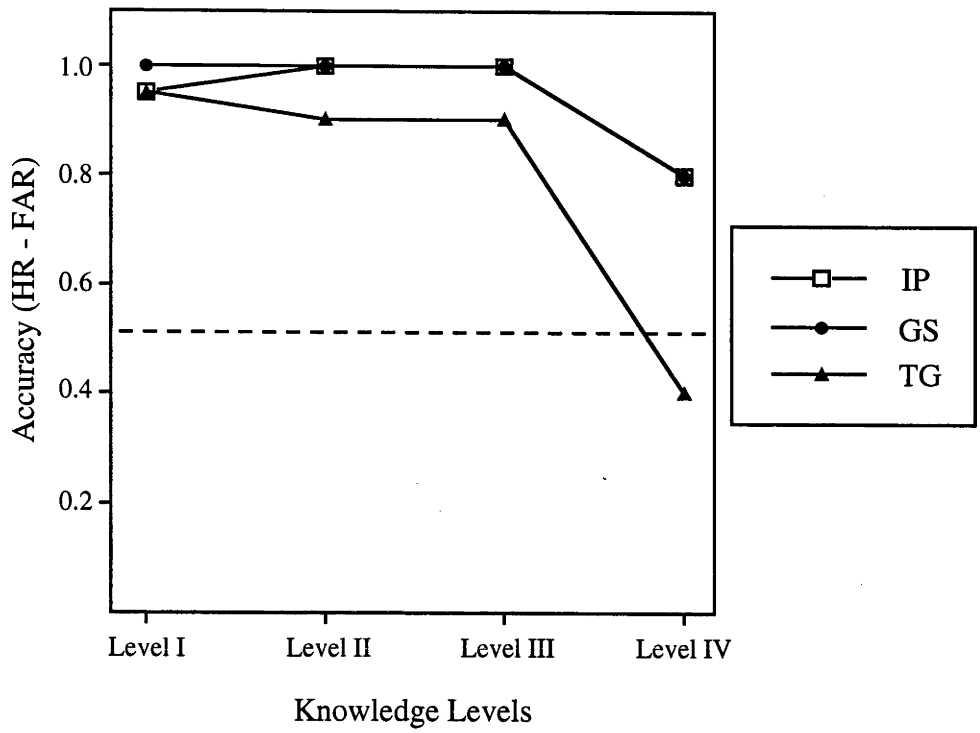
Results for name cues are presented in Figure 8.10. The patient data is presented in Figure 8.10a and the matched control data is presented in Figure 8.10b. Again, TG was the only participant who showed any evidence of impairment on this task, but only at the most specific level of knowledge examined. She was significantly better than chance in discriminating names on the basis of fame ($p < .01$), general occupational category ($p < .01$) and basic occupational category ($p < .01$). However, she did not discriminate between subtypes of actor and subtypes of sportsperson. The errors she made in the latter discrimination were distributed fairly equally across the two occupational groups. IP, GS and the matched controls responded accurately at all four knowledge levels examined ($p < .01$ at all levels).

It was possible that TG's performance with names was facilitated by prior exposure to the same questions since they had been presented first with face cues. To examine this the experiment was repeated three months later, but this time the order of cue presentation was reversed — that is, knowledge was examined first with name cues and then with face cues. Despite the reversal of cues, results on repeat testing were consistent with those obtained on initial examination: TG was significantly better than chance in discriminating names at the first three levels ($p < .01$ at all 3 levels), but could only discriminate faces at the most general level ($p < .05$).

The results of this experiment were consistent with expectations insofar as evidence of impairment was only found in the one patient with RA. In addition, the information she accessed on direct questioning was restricted to higher-level knowledge. Thus, TG's remote memory for public figures, like her autobiographical memory, is characterized by preservation of general-level knowledge and impairment of specific knowledge.

In addition, these results confirm TG's differentiation in memory performance between face and name cues. Performance with name cues was

(a) Amnesic patients



(b) Matched controls

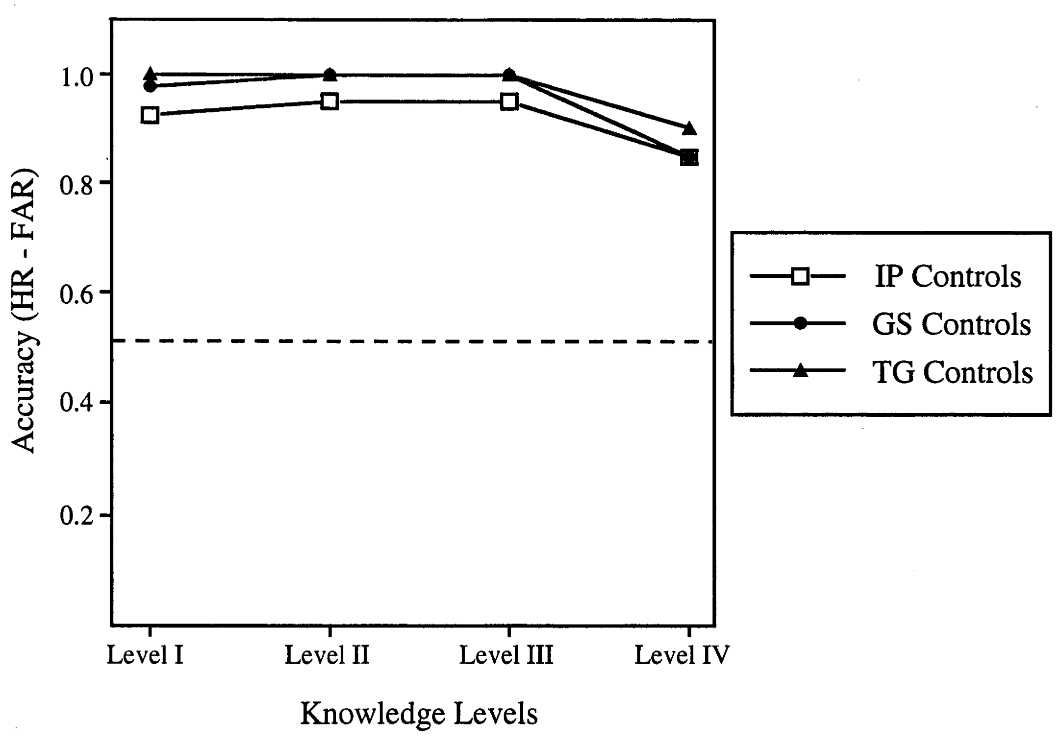


Figure 8.10 Accuracy (as a proportion of hits -false alarms) of yes/no recognition for famous names as a function of level (a) amnesic patients and (b) matched controls.

again clearly superior to that with face cues. It might also be argued that in the case of name cues performance in the autobiographical domain (i.e., in Experiment 6) was marginally better than that in the public domain (i.e., in the present experiment). TG responded accurately at all knowledge levels examined with name cues in Experiment 6, but in this study was only better than chance at the first three levels. Such a result might be explained by the greater strength of representations in the case of autobiographical memories because of their personal relevance (see Snowden, et al., 1994). However, it must also be noted that TG's results in these two experiments are not directly comparable and so, the suggestion that performance in one is better than the other can only be speculative.

Results of this study confirm and extend those of the previous experiments in two important respects. First, preservation of memory for generalities was confirmed, but this time in another domain of remote memory function. Thus, not only does it occur in anterograde amnesia, but it also occurs in retrograde amnesia, both in public and autobiographical domains. Second, there was a difference in performance between faces and names with performance on the former worse than the latter.

8.3 Conclusions from Experiments 6 to 8

The three studies reported in this chapter investigated the generalities phenomenon in RA. Evidence of preserved memory for generalities was found in all three experiments in the one patient who suffered from remote memory impairment. In the public knowledge domain, she remembered general information about famous people better than specific details. A similar pattern of performance was found in autobiographical memory but only for faces. In both experiments there was a difference in the amount of information available to the patient in different modalities. More semantic information about people was available when knowledge was cued with names. This difference between performance with face and name cues will be considered further in Chapter 10.

In two experiments (i.e., Experiment 6 and 8) remote knowledge was examined by asking a series of direct questions. Experiment 7 investigated whether additional information could be accessed if knowledge was tested indirectly, but only in the autobiographical domain. Results indicated that knowledge previously unavailable on direct tests could be accessed using indirect testing procedures. This confirms results of previous experiments reported in Chapter 6, where it was also found that indirect tests facilitated access to knowledge (in this case knowledge about novel associations) in amnesia.

These findings support the claim that the preservation of memory for generalities phenomenon occurs in RA. As these studies investigated the pattern in residual remote memory function, they are also directly relevant to findings of preserved memory for generalities in dementia. Patients with RA and dementia have both lost access to knowledge acquired normally in the past. However, the main difference between these groups lies in the nature of their memory impairment. In dementia the knowledge base has been damaged. As a result of this loss, the residual information is only sufficient to support discrimination at more general levels of knowledge. In TG's case, there is evidence to suggest that retrieval mechanisms are damaged. It was clear from results of Experiment 7 that TG retained sufficient knowledge to differentiate family and friends even though in the previous experiment she failed to make this discrimination. However, additional impairment to the knowledge store cannot be ruled out. For instance, it could be argued that TG's failure to discriminate subtypes of actor and subtypes of sportsperson with name cues in Experiment 8 reflects a storage deficit as this knowledge was not available in either modality. Thus, while the deficit in dementia can be located at storage, the deficit in amnesia may involve a combination of storage and retrieval mechanisms.

A final issue concerns TG's primary diagnosis. Does she suffer from retrograde amnesia or prosopagnosia? If prosopagnosia is considered simply as a deficit in face recognition (see Ellis & Young, 1996), then TG's behaviour is inconsistent with this diagnosis. She could identify faces as familiar and she could access information about people from other modalities (i.e., names). However, her knowledge about people from this alternative modality was not completely preserved as she could not answer all questions asked about famous people. On this basis it might be argued that TG suffers from a mild form of prosopagnosia. Yet all of her behaviour, even with faces, can be explained in the context of RA. There is no reason to expect that knowledge about people should be selectively preserved in cases of remote memory loss. In TG's case, the remote memory impairment affected knowledge in several domains (i.e., public, autobiographical) and was not restricted to people (i.e., it also affected episodic knowledge, as indicated by her responses to such questions on the Autobiographical Memory Interview). Although a diagnosis of mild prosopagnosia in addition to amnesia cannot be excluded, it seems that TG's condition can be explained by RA alone and on this basis it is argued that this represents the most parsimonious and hence the most appropriate diagnosis.

Chapter 9

Memory for generalities in a non-impaired sample[6]

The studies reported in earlier chapters provide evidence that memory for generalities previously reported in patients suffering particular forms of dementia also occurs in both anterograde and retrograde amnesia. Thus, the differentiation between high- and low-level knowledge characterizes the memory disturbance in very different clinical populations. It is possible that this pattern of residual memory performance is a consequence of brain damage common to all three conditions. However, there is another interpretation — namely, that preservation of memory for generalities is simply a normal feature of poor memory, irrespective of its cause, and its occurrence in clinical cases simply reflects their acquired memory deficit.

In support of this, there is evidence of superior memory for generalities in people without memory impairment. For instance, a differentiation between general and specific knowledge is evident in semantic confusions which are common in everyday behaviour (e.g., confusing one colleague's name with that of another) and have also been demonstrated in the laboratory. Bartlett's (1932) classic experiment, involving the "The War of the Ghosts" story, provides an early demonstration of the errors that people make when attempting to recall specific details following delay (up to 10 years in one case). He found that people tended to add or modify details (e.g., "something black" was transformed into "foamed at the mouth") in order to make the story more consistent with their

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[6] The material presented in this chapter is reported in Haslam et al. (in press).

expectations. The most specific details, such as proper names, were the most commonly omitted in recall. Yet despite these errors, the general theme of the story was retained.

A similar pattern of semantic confusion has been demonstrated in more recent studies of memory illusions. For example, Bransford and Franks (1971) found evidence of semantic confusion in sentence recognition. They examined memory by asking participants to differentiate between studied, semantically-related (i.e., non-studied) and unrelated sentences. While participants rejected the unrelated sentences with ease, they had difficulty differentiating studied from semantically-related sentences. This suggests that participants had retained generic knowledge, about the theme or idea presented in sentences, but not sufficient specific knowledge to identify them as the ones encountered at study. Deese (1959) developed a paradigm to investigate memory distortion in recall of items from word lists. The task simply involved presenting a list of related words during study (e.g., hill, valley, summit, etc.) and then testing recall. A high rate of intrusion errors was found. Specifically, there was a significant tendency to report words that were strongly associated with the studied items (e.g., mountain) even though they had not been presented. This paradigm has since been adopted by other researchers who report a similar pattern of memory distortion in normal samples (e.g., Roediger & McDermott, 1995; Schacter, et al., 1996). Again, a differentiation between high- and low-level knowledge is indicated in these results.

The tip-of-the-tongue (TOT) phenomenon can be seen as another example of superior memory for generalities in normal individuals. This effect is characterized by an inability to recall a word or name in the context of partial knowledge about the item. Several researchers have attempted to identify the components of this residual knowledge and have found that it is of two general types. One type consists of structural or phonemic information about the target such as syllable length, its sound and knowledge about the first letter (e.g., Brown & McNeill, 1966; Jones, 1989; Lovelace, 1987). The second type, which is of greater relevance to the current discussion, is semantically-related information. This includes, for example, knowledge about a person's profession (e.g., Lovelace, 1987; Yarmey, 1973). In fact, Yarmey (1973) found that partial semantic knowledge is more important in attempting to overcome the TOT state, at least in the case of naming famous people. This pattern of preserved memory for semantic information and temporary impairment of item-specific knowledge is consistent with that described here as the "generalities phenomenon".

These studies suggest that even non-clinical samples can remember general information better than specific details. This pattern tends to present when an increased burden has been placed on memory (e.g., by presenting information that is strongly related to studied materials or by increasing the delay between study and test). Thus, the generalities phenomenon may not be restricted to clinical populations, but rather, may occur in any situation where memory is imperfect.

9.1 Experiment 9: Investigation of the generalities phenomenon in a non-clinical sample

Although the evidence is strongly indicative of better memory for generalities in normal populations, the techniques used differ from those employed in the present program of research. This final experiment was conducted to determine whether non-clinical populations would, under conditions of imperfect memory, display the generalities phenomenon using the same techniques employed here with amnesic patients.

To achieve this aim, the first three experiments (reported in Chapter 6) were repeated in a non-clinical sample. These experiments investigated memory for face-occupation associations. Results of these experiments revealed the following phenomena in amnesic patients. When asked to make a coarse discrimination in Experiment 1, response confusions indicated that patients could identify the higher-level occupational grouping (i.e., discriminate educators from tradespeople) but failed to identify the lower-level occupation (i.e., discriminate subtypes of teacher and subtypes of lecturer). This pattern of results could not be explained solely in terms of the absolute levels that were used in our taxonomic hierarchy because introduction of a more refined discrimination in Experiment 2, where lower-level occupations studied in the previous experiment became the higher-level occupational grouping, led to an improvement in memory performance in at least one patient. In Experiment 3, patients could not identify the occupational grouping when knowledge was examined directly in either coarse (i.e., in Experiment 1) or fine (i.e., in Experiment 2) discrimination tasks.

To investigate these phenomena in a non-clinical population Experiments 1, 2 and 3 were repeated. The only changes in procedure were first, a reduction in exposure during study to induce partial learning and, secondly, presentation of items on video to facilitate group administration. The suboptimal learning conditions, while not rendering participants amnesic, were intended to reduce performance sufficiently for memory to qualify as imperfect. The primary aim was to determine whether non-clinical subjects would show preservation of memory for generalities analogous to that seen in our amnesic patients. In addition, we wished to examine the relative contributions of response mode (i.e., direct vs. indirect testing) in non-clinical subjects.

Method

Design

As illustrated in Figure 9.1, the experiment had a 2 (level in taxonomic hierarchy: high/low) x 2 (type of test: direct/indirect) design with repeated measures on the first factor (see Figure 9.1). The dependent variable was memory performance in a yes/no recognition test of the occupation associated with each face.

Participants

111 (73 females and 38 males; mean age = 22.97 years, SD = 6.06) undergraduate psychology students participated as part of their second year laboratory program in cognitive psychology. There were 58 subjects in the indirect test condition and 53 subjects in the direct test condition.

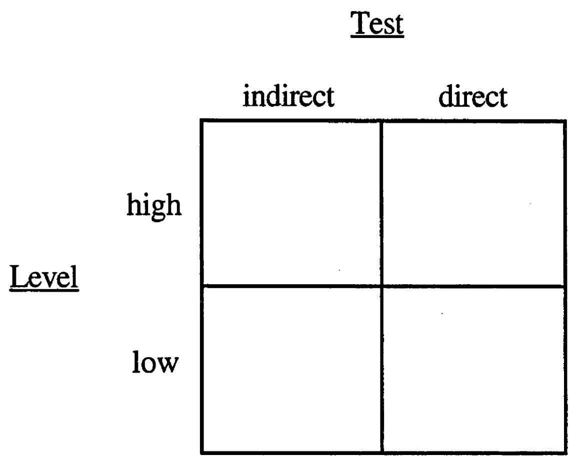

Figure 9.1 Design of Experiment 9

Materials

Materials consisted of two sets of face-occupation associations and four lists of occupations. The face-occupation associations were identical to those used in Experiments 1 and 2, with the exception of two faces — one from each experiment (both were lost due to technical difficulties). These were replaced with other faces that resembled the original items as closely as possible (i.e., factors such as age and presence of facial features were controlled). The 28 male faces in each set were divided equally into four occupations. The occupations in Experiment 1 comprised "teachers, lecturers, electricians and plumbers" (Level II). These could be classified at the higher-level of "educator" and "tradesperson" (Level I). In Experiment 2 the occupations comprised "high school teachers, primary school teachers, university lecturers and TAFE lecturers" (Level III), which could be categorized at the higher-level of "teacher" and "lecturer" (Level II).

These materials were presented in two video recordings. One video contained the stimulus materials from Experiment 1 followed by those from Experiment 2. The second video contained the same information but in the reverse order. There were two sets of materials in each experiment. One set was used in the study phase and the other set was used in the test phase. In the study phase 28 face-occupation associations were shown. These were presented individually for 3 secs followed by presentation of a blank screen for 1 sec before the next item appeared. This duration of exposure was determined in the course of pilot testing ($\underline{N}$ = 6) in which the aim was to identify the amount of study required to render memory imperfect. In the test phase the same faces were presented again in a different order, but this time without occupations. These latter items were presented individually for 5 secs and then a blank screen appeared for a period of 10 secs before the next face was shown. The order of item presentation in both parts of each experiment was the same as that for Experiments 1 and 2.

Four lists of occupations were used to examine knowledge of face-occupation associations. Two lists contained the four studied occupations (i.e., teacher, lecturer electrician, plumber for Experiment 1 and high school teacher, primary school teacher, university lecturer, TAFE lecturer for Experiment 2) and the remaining lists contained two higher-level occupations (i.e., educator, tradesperson for Experiment 1 and teacher, lecturer for Experiment 2).

Procedure

The experiment was conducted in two phases. In one phase items from Experiment 1 (used in making a coarse occupational discrimination) were presented and in the other phase items from Experiment 2 (used in making a fine occupational discrimination) were presented. All students participated in both phases of the experiment, but half were presented with materials from Experiment 1 followed by those from Experiment 2 and the remaining students were presented with the same materials in the reverse order. This was achieved by having participants in each laboratory class view one of two video screens. The screens were placed back-to-back in the middle of the class facing opposite ends of the room. As students entered the room they were directed to sit in front of one of these screens. This randomized group assignment and also kept the number of participants viewing each video approximately equal.

Two tests were used to examine memory. Half of the participants (i.e., 3 classes) received indirect tests of higher-level knowledge and the other half received direct tests of higher-level knowledge. The type of test employed was the same in both phases of the experiment in each subject. Different occupational lists were used depending on the nature of the test. When memory was tested indirectly participants received occupational lists that contained the four studied professions. When memory was tested directly participants received occupational lists that contained only two higher-level professions.

At the start of the experiment participants were told that there were two phases to the experiment and that in each phase their memory about people and number sequences was going to be examined. They were asked to attend to the video screen on which they would see a series of face-occupation associations. Participants were told that their task was to remember these associations and that their memory for these associations could be tested in a variety of ways. They could either be asked to remember the specific occupations or more general information about them. The first set of face-occupation associations (either from Experiment 1 or Experiment 2) was then presented.

Immediately following presentation of face-occupation associations, participants were given a distractor task — the digit-span subtest from the Wechsler Adult Intelligence Scale-Revised (Wechsler, 1981). Instead of responding verbally, they were asked to write their responses down. They were encouraged to list as many digits in the sequence as they could remember. In the case of digits backwards, they were instructed to be honest when writing their responses, starting with the last digit from left to right and not from right to left. Apart from these modifications, administration of the task was consistent with standardized procedure. This distractor task, took about 10 minutes to administer. After it had been completed, participants were shown the faces they had seen earlier and were told to identify the occupations of each person whose face they were shown using the list of professions provided. They were encouraged to provide a response for every item and if they could not remember the occupation they were instructed to guess.

This entire procedure (study, distractor and test) was repeated in the second phase of the experiment with a different set of face-occupation associations (i.e., if stimulus materials from Experiment 2 were presented first then participants were presented with stimulus materials from Experiment 1 or vice versa) and a different version of the digit-span test. In this phase the digit span subtest from the Wechsler Memory Scale-Revised (Wechsler, 1987) was used. Because there were fewer items in this version of the digit-span test, four number sequences containing eight digits were added to the test — two were added to the digits forward component of the task and two were added to the digits backward component of the task.

Results and Discussion

Results for the two types of discrimination, coarse (i.e., repetition of Experiment 1) and fine (i.e., repetition of Experiment 2), will be discussed separately to facilitate comparison with results from amnesic patients. Figures 9.2 and 9.3 are both relevant to the discussion of results from coarse and fine discrimination tasks. Figure 9.2 shows results for indirect tests of knowledge for higher-level categorization. The top panel of this figure shows within-category performance for each type of discrimination and the bottom panel shows between-category performance. Figure 9.3 shows results for both direct and

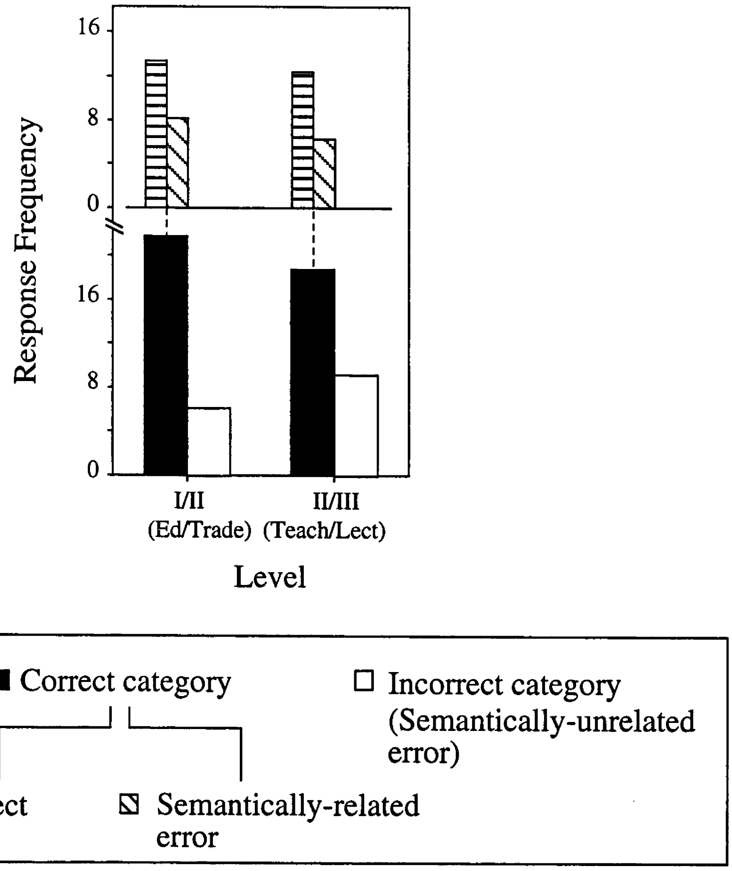

Figure 9.2 Indirect measures of higher-level knowledge in a non-clinical group.

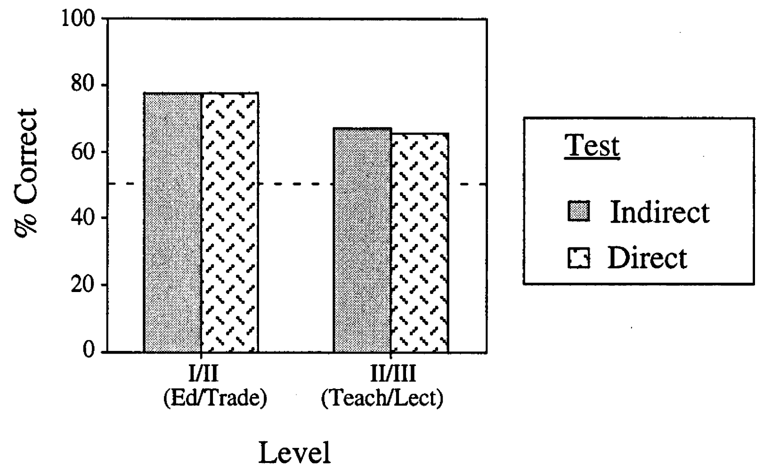

Figure 9.3 Comparison of direct and indirect measures of higher-level knowledge in a non-clinical group.

indirect tests of knowledge for higher-level categorization. In this figure, memory performance is measured by a percentage of correct responses and the dotted line shows the point at which the score was significantly better than chance.

(i) Coarse occupational discrimination (Level I/II): The left side of Figures 9.2 and 9.3 show the distributions of judgements involved in coarse discrimination of occupational categories. The critical question was whether accuracy of between-category judgements would be better than accuracy of within-category judgements. As indicated in Figures 9.2 (top panel, left side) and 9.3 (left side) participants performed above chance in making within-category judgements on both direct and indirect tests (i.e., direct: $t(52) = 16.89$, $p < .0001$; indirect: $t(57) = 5.93$, $p < .001$). This means that unlike our clinical sample, our non-impaired sample could remember the specific professions associated with the faces. This was in spite of the limited exposure to these materials during study.

Nevertheless, there was evidence of superior memory for generalities in the non-clinical sample. Discrimination of occupations was better at the more general level of classification (i.e., at Level I) as evidenced by response confusions. Accuracy was measured in terms of the proportion of correct responses for each type of discrimination — for between-category judgements correct-category responses were divided by the total number of responses and for within-category judgements correct responses were divided by the number of correct-category responses. Accuracy of between-category judgements was significantly better than accuracy of within-category judgements ($t(57) = 10.13$, $p < .0001$). That is, participants were better at differentiating educators from tradespeople than they were in differentiating subtypes of educators and subtypes of tradespeople.

These findings indicate that the performance of non-clinical participants was similar to that observed in amnesic patients when making a coarse discrimination (i.e., in Experiment 1). In both cases there was a clear superiority in discriminating faces at the higher-level occupational grouping. However, unlike patients, our non-clinical sample could also identify lower-level occupations.

(ii) Fine occupational discrimination (Level II/III): The right side of Figures 9.2 and 9.3 show judgements for the more refined occupational discrimination. As was the case for coarse discrimination, participants were significantly better than chance in discriminating faces on the basis of the specific occupations they had studied both on direct ($t(52) = 10.97$, $p < .0001$) and indirect ($t(57) = 7.25$, $p < .001$) tests of knowledge. Thus, irrespective of the type of test, participants accurately discriminated lower-level occupations involving subtypes of teacher and subtypes of lecturer.

However, in this case, no difference was found in the accuracy of between- and within-category judgements ($t(57) = 0.66$, ns) and this result differs from that observed in the coarse discrimination task. Thus, the non-clinical participants were no better in discriminating faces at the higher-level than they were in discriminating them at the lower-level. This pattern of performance contrasts with that observed in amnesic patients for the same type of discrimination (i.e., in Experiment 2). Amnesic patients had greater difficulty discriminating faces at the higher-level occupational grouping as their memory for generalities was only better than chance on several trials. Two factors may have contributed to the pattern of performance observed in these groups. It is possible that the professions studied at Level II/III (i.e., subtypes of teacher and subtypes of lecturer) were more meaningful for the non-clinical group and hence more salient. Educator-related professions may have been particularly important to these participants because they were university students and this may have increased the accuracy with which they recalled these particular face-occupation associations. At the same time, another factor may have contributed to the poor performance of amnesic patients in this condition. For them, the professions involved in the fine discrimination (i.e., Level II/III) may have been less meaningful than those involved in the coarse discrimination (i.e., Level I/II). For people outside of the education system, subtypes of teacher and lecturer may have more attributes in common than subtypes of educator and trade. This may have increased the difficulty in associating the professions with faces even at the higher-level of generality.

A second analysis was conducted comparing performance in the two discrimination tasks (i.e., coarse and fine) to address the issue of what constitutes a "generality". This analysis paralleled that used in Experiment 2. The teacher/lecturer discrimination was a low-level categorization in the coarse discrimination task and a high-level categorization in the fine discrimination task. Educator-related items only were included in this analysis (i.e., trade-related items at Level I/II were excluded). The ability to discriminate teachers from lecturers was significantly better in the fine discrimination task, where this distinction represented a higher-level of categorisation ($t(57) = 2.58$, $p < .05$). Thus, as was the case with amnesic patients, the ability of the non-clinical sample to discriminate teachers from lecturers improved with a change in study context. Performance was best when the teacher/lecturer distinction represented the general level of categorization in a context where subtypes of teacher and lecturer were studied. This result provides further evidence against the role of an absolute level in the taxonomic hierarchy determining "generality" (e.g., basic level categories). Rather, it suggests that "generality" is relative and that it is influenced by the context in which information is encountered.

Finally, the influence of test type (direct or indirect) on memory performance was examined. In the coarse discrimination task, accuracy of responding on direct and indirect tests of higher-level categorization was 77%. In the fine discrimination task participants identified 67% of occupations correctly in indirect tests and 65% in direct tests. A 2x2, level x test type, ANOVA revealed a main effect of level ($F(1, 109) = 71.94$, $p < .0001$) only. Thus, irrespective of the type of test administered, memory performance was best when knowledge at the top of our occupational hierarchy was examined. In fact, the type of test had no influence on memory performance at all. Non-clinical participants were just as accurate in identifying professions when tested indirectly as they were when tested directly. This result is of considerable interest in view of the findings of Experiment 3, and it clarifies the influence of response mode in producing the generalities effect. In the amnesic patients clear evidence of the generalities phenomenon was only found in the indirect tests of higher-level knowledge, and this raised the possibility that the apparent preservation of memory for generalities in the earlier experiments was a consequence of testing method. However, the results obtained with the non-clinical sample indicate that superior memory for generalities is not simply a consequence of indirect testing. If it were, then differences should also have been found in performance on these two tests in non-clinical subjects.

We can draw several conclusions from results of this experiment. First, non-clinical participants show better memory for generalities than specifics under suboptimal learning conditions. That is, the generalities phenomenon is not confined to the brain-injured. Second, like amnesic patients, non-clinical participants also showed improvement in memory performance with a change in study context. However, the performance of non-clinical participants did not mirror that of amnesic patients in one important respect. Mode of testing had no effect at all on the memory performance of our non-clinical sample although it had a substantial influence (at least in Experiment 1) on the performance of our amnesic patients. This suggests that preservation of memory for generalities in amnesic patients is not simply a consequence of poor memory. It is likely that another feature of amnesic memory is responsible for producing the difference observed on the direct and indirect tests, though it is not clear what this feature may be.

Chapter 10

Preserved memory for generalities in amnesia: Conclusions

10.1 Overview

This thesis has examined an aspect of residual memory in amnesia. The phenomenon investigated involves the dissociation of higher-level category knowledge from exemplar knowledge and is described here as *preservation of memory for generalities*. This phenomenon has previously been demonstrated in certain forms of dementia. The present research showed that the effect also occurs in both anterograde and retrograde amnesia. This finding is important as it indicates that the generalities phenomenon is not restricted to pre-existing knowledge. Furthermore, the effect also presents in non-impaired individuals when partial learning has been induced. Thus, it appears that, irrespective of pathology, when knowledge is imperfect superior memory for generalities is manifested.

A number of specific conclusions were drawn from results of the experiments investigating this phenomenon. These are summarised in Table 10.1. Caution is required in interpretation of some of these findings, largely due to limitations in both the sample size (i.e., of amnesic patients) and the number of items used to examine knowledge. While several firm conclusions can be drawn about the occurrence of the phenomenon in both forms of amnesia at intermediate levels of "generality", those concerning the role of context and evidence of the phenomenon at lower levels of "generality" (e.g., at the level of teacher/lecturer) are more speculative.

TABLE 10.1

Summary of the main findings from empirical chapters

Temporal domain/participants	Chapter	Findings (experiment)
A. New learning/AA	6	1. Preservation of memory for generalities in anterograde amnesia (Exp 1)
	6	2. Study context influences preservation of memory for generalities suggesting that the level of "generality" which is preserved is relative and not absolute (Exp 2)
	6	3. Differentiation in performance between direct and indirect tests of higher-level knowledge: Evidence of memory for intermediate-level generalities on indirect tests only (Exp 3)
	7	4. Direct access to higher-level knowledge if information is sufficiently general (Exp's 4 & 5)
B. Remote knowledge/RA	8	5. Preservation of autobiographical memory for generalities (Exp 6)
	8	6. Facilitation in access to autobiographical information using indirect tests of higher-level knowledge (Exp 7)
	8	7. Preservation of remote memory for generalities in the public domain (Exp 8)
	8	8. Differential access to knowledge in response to faces and names (Exp's 6 & 8)
C. New learning/non-clinical	9	9. Superior memory for generalities in non-impaired participants (Exp 9)
	9	10. No effect of direct/indirect testing in non-impaired participants (Exp 9)

There are five issues arising from these results and these concern:

- evidence of the generalities phenomenon in old and new memory,
- the influence of direct and indirect testing,
- the role of context,
- the presence of the phenomenon in non-clinical populations, and
- differential access to knowledge about people in response to faces and names.

While the latter finding is peripheral to the present investigation into preserved memory for generalities, it requires some explanation given its importance to models of face recognition.

Evidence of superior memory for generalities in both the amnesic patients and the non-impaired might highlight nothing more than a quantitative difference between the clinical and non-clinical groups. However, there was one aspect of amnesic performance that clearly differentiated this group from the non-impaired and, indeed, from dementia sufferers. At intermediate levels of "generality" the amnesic patients accessed more information on indirect measures of higher-level knowledge than they did on direct measures. No difference was found on this dimension in the non-impaired group and reports of the phenomenon in dementia indicate that these patients can provide intermediate level "generalities" in response to direct questions (e.g., Funnell, 1995; Hodges et al., 1994; Martin, 1987). Although there were other issues arising from results of the present research, this difference in performance on direct and indirect tests is critical in differentiating the memory disturbance in amnesia from other manifestations of poor memory.

Explanations of preserved memory for generalities in dementia have some bearing on its occurrence in amnesia. There are two main theories proposed to explain the phenomenon in dementia[7]. According to the familiarity/frequency account (Funnell, 1995), exemplar knowledge is more vulnerable to damage due to its reduced representational strength. It is proposed that this arises from its low frequency of occurrence in language. No assumptions of selective vulnerability are made in the alternative theory, referred to as the fragmentary knowledge account. In this case it is argued that the residual "fragmentary" representation that results from damage is sufficient to support more general-level, but not specific-level, knowledge (e.g., Hodges et al., 1995). The two theories differ in that the fragmentary knowledge account assumes that the loss of information is random. The superior performance with generalities occurs because this level of representation can be accessed from a reduced data base.

Either of these theories could be appropriate in consideration of preserved remote memory for generalities in RA, as this form of amnesia (like dementia) involves damage to pre-existing representations. However, some modification is required to explain findings from patients with AA. Assumptions about the formation or retrieval of memory traces (e.g., that patients form fragmentary representations) must be made for accounts of a "fragmentary knowledge" type or a "familiarity/frequency" type to be applied. Theories of amnesia, while not particularly relevant to the generalities phenomenon, also have some bearing on specific issues arising from results of this investigation. The relevant accounts involve the semantic-episodic and the implicit-explicit distinctions as well as the

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[7] Collins and Quillian's hierarchical model was considered earlier in Chapter 3 for historical reasons. It is not included in the present discussion because there is considerable evidence that suggests it does not provide a plausible account of semantic memory structure (e.g., Barsalou, 1987; Rips et al., 1973).

contextual memory deficit hypothesis. These will be considered in discussion of specific issues in the following section.

10.2 General theoretical implications of findings

10.2.1 Which knowledge domain?

Before considering the theoretical implications of the results, it is important to consider the knowledge domain or system involved in these experiments. This is because confusion may arise when comparing memory for generalities in amnesia with that observed in patients suffering from dementia. As with investigations of the generalities phenomenon in dementia, the tasks used in the present studies involved semantic memory because the experiments focused on examination of factual knowledge about people. However, the present work differs from the work with dementia in terms of the aspect of semantic knowledge targeted. In dementia, the reported preservation of memory for generalities results from a gradual deterioration of the concepts themselves. This is not the case in the present study. It was clear that amnesic patients had no conceptual difficulty with the faces, names or occupations used in the experiments. They understood occupational relationships (e.g., that a violinist is a musician and an entertainer) and had knowledge of the general structure of faces and the connotation of names. In these experiments, the generalities phenomenon resulted from a difficulty in *associating* lower-level attributes with a person's face or name — not from a deficiency in processing these particular concepts. The effects reported here do not concern a deficit in semantic memory per se.

At a superficial level it might be argued that the deficit in anterograde amnesia lies in the *formation* of these associations, while that in retrograde amnesia results from the *loss* of these associations. While other sources of disruption are possible (e.g., the deficit could be located in retrieval of associations), the point of this discussion is to highlight the fact that the nature of the memory breakdown in the two patient groups differs. Having said this though, it is still possible that the same fundamental mechanism is involved in producing differential memory for high- and low-level information in both patient groups. It is possible that the same process is operating but that it is affecting different aspects of knowledge (i.e., the concepts themselves versus associations between concepts) in the different patient groups.

10.2.2 Explaining preservation of memory for generalities in amnesia

The two main theories proposed to explain the differentiation between categorical and exemplar knowledge in dementia — the familiarity/frequency and fragmentary knowledge accounts — are the most relevant to the present investigation of a similar phenomenon in amnesia. As several accounts of amnesia are pertinent to particular findings, they will be considered in a subsequent section addressing each of these issues. It will be seen that some of these theories are consistent with our observations and some are not. A summary of this is presented in Table 10.2.

Familiarity/frequency

One account of the dissociation of categorical from exemplar knowledge in dementia is provided by Funnell (1995) who attributes this to the selective vulnerability of items that are lower in familiarity or frequency. It is argued that item-specific information is relatively poorly represented in memory and hence is more vulnerable to destruction. Accordingly, knowledge about flowers may be preserved relative to that concerning a specific type of flower (e.g., daffodil) because the former concept has been encountered with greater frequency than the latter.

In applying a theory of this type to investigations of AA we must bear in mind that the present amnesic patients showed a deficiency in the formation of novel *associations* between occupations and faces. There was no evidence that our patients had deficits in visual perception or semantic memory (see Chapter

TABLE 10.2

Evaluation of theories directly relevant to the investigation of preserved memory for generalities

	Dementia		Amnesia		
Issues	Fragmentary	Frequency	Sem-Epis	Imp-Exp	CMDH
1. Old and new memory for generalities	✓	X	X	--	--
2. Direct and indirect testing	--	--	--	X	--
3. Context	✓	X	--	--	X
4. Generalities in non-clinical populations	✓	X	--	--	--

✓ = accounts for data; X = does not account for data

Imp-Exp: implicit-explicit; Sem-Epis: semantic-episodic; CMDH: contextual memory deficit hypothesis

5). An account based solely on familiarity or frequency therefore does not explain the differentiation found between high- and low-level knowledge. Our patients were *never* presented with the higher-level occupational categories during study. Even if other sources of vulnerability (apart from familiarity and frequency) can be identified, there remains the fundamental problem of explaining preservation of knowledge about concepts that were not explicitly learned. Thus, in the present experiments, the effects of familiarity and frequency, or any other factor which might make higher-level categories less vulnerable, are irrelevant.

A frequency-based account is more successful in explaining the results of the experiments examining remote memory for generalities in the patient with RA. Knowledge of the general attributes about a famous person (e.g., that they are famous and an entertainer) may be preserved because they have been encountered with greater frequency. For example, after damage to their memory a person may retain the fact that John McEnroe is famous because on every occasion he was encountered (i.e., on television, radio, etc.) his status as a famous person was highlighted. On the other hand, the fact that he is a tennis player may not have been salient on every occasion. As a result, the person's ability to recall the latter attribute may be impaired because it has been encountered on fewer occasions and hence is more vulnerable to destruction. However, this type of argument breaks down when memory for face-name associations is considered. It could be argued that names are encountered with greater frequency than faces. In the case of famous people, a person's name can be encountered on the radio or in a newspaper with no reference to their face. Similarly, the name of a family member may come up in conversation without exposure to their face. From this, one might predict that knowledge for face-name associations should be better than that for associations between faces and other higher-level attributes. Yet in both public and autobiographical domains, the one patient we studied with RA failed to make face-name associations despite having access to knowledge of associations at the more general levels. As was the case for new learning then, a frequency-based account fails to provide an adequate explanation of the pattern of residual knowledge in RA.

Fragmentary knowledge

An account of the fragmentary knowledge type fares better in explaining the present findings in both temporal domains. Such an account could be applied to new learning if it is supposed that patients acquire only an arbitrary subset of the semantic features of items encountered during study (e.g., target materials or context). For example, in learning to pair a face with a "teacher" (as in Experiment 1), a normal subject may form associations between the face and a range of education-related semantic attributes, including those which specify the occupation as teacher rather than lecturer. In the case of amnesia the attributes acquired may be limited, perhaps representing a subset of those available to a non-impaired subject. If amnesics form only a partial set of associations, then their knowledge may be sufficient to support higher-level but not lower-level categorical distinctions. Thus, the partial set of attributes may have been sufficient to exclude non-educational occupations (i.e., to discriminate educators from trades), but not to distinguish subtypes of educator.

The fragmentary knowledge account can also be applied to pre-existing knowledge. Assuming that the memory loss in retrograde amnesia is partial, then the residual knowledge may be sufficient to support high-level but not low-level associations. For example, a patient with impaired remote memory may retain knowledge that Mel Gibson is an actor (see Figure 10.1), this would be sufficient to support fame judgements. However, this knowledge may not help to discriminate him from another actor. Irrespective of the combination of attributes retained, partial knowledge is more likely to facilitate accuracy on tests of higher-level knowledge.

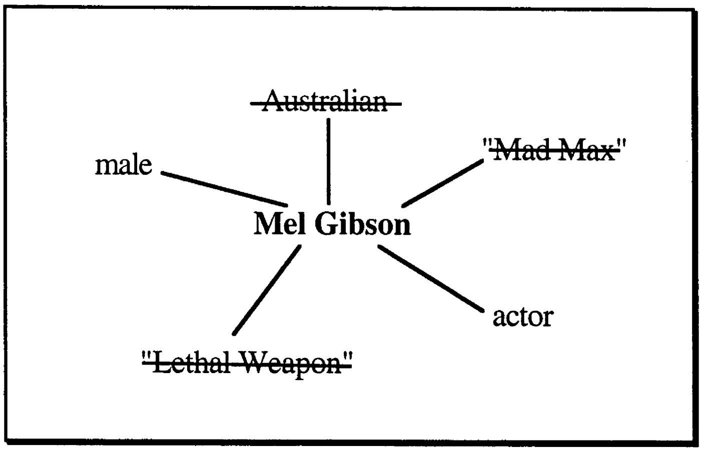

Figure 10.1 A hypothetical fragmentary representation of Mel Gibson [Note: despite loss of particular details, sufficient information remains to support performance on tests of higher-level knowledge]

Of these theories, only an account of the fragmentary knowledge type is able to explain the preservation of memory for generalities in both retrograde and anterograde amnesia. In both temporal domains partial knowledge is sufficient to support performance on tests of "generality" without making assumptions about the structure or vulnerability of particular memory representations. Importantly, a theory developed to explain a phenomenon previously believed to characterize particular forms of dementia is successful in accounting for a similar phenomenon in amnesia.

10.2.3 Specific issues arising from the results

Preservation of old and new memory for generalities

In dementia, the dissociation of exemplar from categorical knowledge seemingly results from a gradual deterioration to pre-existing knowledge. However, in amnesia the memory disturbance can affect both remote and newly acquired knowledge and thus, the generalities phenomenon was investigated in both temporal domains. The experiments reported in Chapters 6, 7 and 8 are relevant to this issue and their results indicated that both anterograde and retrograde amnesics remembered higher-level category membership better than lower-level category membership.

The clearest example of preserved memory for generalities in AA was provided in Experiment 1. Here patients were asked to remember specific face-occupation associations (comprising teachers, lecturers, electricians and plumbers) but they were only successful in discriminating studied people on the basis of higher-level occupational groupings (i.e., educator, tradesperson). In other words, their memory for general-level information about face-occupation associations was preserved and person-specific knowledge was impaired. This pattern of preserved memory for generalities in new learning was confirmed in Experiments 4 and 5 which examined knowledge at a range of levels, from the very general to the very specific. Again, the same pattern of differential memory performance was found, with higher-level information remembered better than lower-level detail. Thus, amnesic patients demonstrated the same pattern of preserved memory for generalities previously reported in dementia, but for them this pattern was manifested in relation to material acquired *after* the onset of memory disturbance.

To determine whether the generalities phenomenon occurred in retrograde amnesia, another series of experiments was conducted with the one patient who suffered from this form of the disturbance. In the domain of remote public memory (i.e., in Experiment 8), knowledge at the most general levels was retained and that at more specific levels was impaired. Although the amount of knowledge the patient could access about people from their faces and names differed, the same pattern of preserved memory for generalities was found with both cue types. A similar pattern of preserved autobiographical memory for generalities was found in Experiment 6 in response to face cues. In this experiment the patient accurately discriminated people at the most general levels examined (i.e., supporting familiarity judgements and discrimination of personally known from famous people) but failed to make more specific discriminations. Thus, in one patient, evidence of preserved memory for generalities was found in relation to material acquired *before* the onset of amnesia.

Given that the generalities phenomenon presents in both anterograde and retrograde amnesia, it is appropriate to ask whether this has any implications for the relationship between these two forms of memory disturbance. If the preservation of memory for generalities is considered to be a characteristic feature of amnesia then it might be argued that retrograde and anterograde amnesia are different manifestations of the same syndrome because they share a common residual memory profile (i.e., preservation of higher-level knowledge and impairment of lower-level knowledge). However, the evidence suggests that the generalities phenomenon is not unique to particular conditions. It has now been demonstrated in dementia, amnesia and in a non-impaired sample. This suggests that the phenomenon occurs whenever there is a deficiency in memory, irrespective of whether past or newly acquired knowledge is involved. If the generalities phenomenon is characteristic of memory in general, it tells us nothing about the relationship between retrograde and anterograde amnesia.

An important question is whether acquisition or retention of partial knowledge can be accommodated within existing accounts of amnesia. One account which might be invoked to explain acquisition of partial knowledge in amnesia is based on a distinction between semantic and episodic memory. Superficially, the partial learning observed in our patients is consistent with the argument that semantic memory is preserved in these patients. Patients learned to associate novel faces with existing knowledge concerning occupations. To that extent the new learning was supported by semantic memory (given that the novel information acquired was factual) and by pre-existing knowledge (given that the occupations were known to patients prior to the onset of their amnesia).

However, the semantic-episodic distinction does not address the observed differentiation between higher- and lower-level knowledge. Accordingly, this account provides no basis on which to expect that associations with specific occupations would be more difficult to acquire, given both higher- and lower-level occupations were known to the patients.

In addition, the semantic-episodic distinction has little to offer as an explanation of partial knowledge in retrograde amnesia. All tests of remote memory required participants to access semantic knowledge, irrespective of whether high- or low-level information was involved. Preservation of high-level semantic knowledge together with impairment of low-level semantic knowledge cannot be explained by an intact semantic memory system.

Performance on direct and indirect tests of higher-level knowledge

In Chapter 6 it was shown that amnesic memory performance was influenced by the type of response, direct or indirect, engaged at test. While patients could not discriminate between people on the basis of studied occupations (e.g., involving teachers, lecturers, electricians and plumbers in Experiment 1), their response confusions indicated that they had acquired sufficient knowledge to discriminate between them in terms of their higher-level occupational groupings (i.e., as educators or tradespeople). In this case examination of knowledge at the higher-level was indirect because no reference was made to these occupations. However, patients failed to make the same discrimination when questioned directly about higher-level occupational membership in Experiment 3. Similarly, indirect tests facilitated access to remote autobiographical information that was not available under direct testing (i.e., in Experiment 7).

These findings suggested that the generalities phenomenon itself, as demonstrated in Experiment 1, might be a consequence of testing procedure. However, this explanation was discounted on the basis of results from the experiments reported in Chapters 7, 8 and 9. In Chapters 7 and 8, it was shown that amnesic patients were capable of accessing higher-level knowledge in response to direct questions when the information elicited was sufficiently general (i.e., at intermediate levels of "generality"). In Experiments 4 and 5, two patients accessed higher-level information about novel people directly. Results from the third patient (i.e., TG) were not conclusive as she was only accurate when making familiarity judgements that could have been supported by either implicit or explicit knowledge. In Experiments 6 and 8, there was evidence of direct access to higher-level autobiographical and public knowledge in the one patient who suffered from retrograde amnesia. Together these findings indicate that the generalities phenomenon cannot be attributed to testing conditions alone.

The results of Experiment 9 provide additional support for the notion that preservation of memory for generalities is not simply a consequence of testing procedure. This study was essentially a replication of the first three experiments with non-clinical participants. As was the case with amnesic patients, non-clinical participants remembered general information better than specific detail. However, in this case there was no difference in performance on direct and indirect tests of higher-level knowledge. If the generalities effect were solely a function of indirect testing then a difference should have been observed between the two methods of testing.

One theory from the amnesia literature, based on the distinction between implicit and explicit memory, was considered in Chapter 6 as a possible explanation of amnesic performance on direct and indirect tests. The possibility was considered that enhanced memory performance on indirect tests might have been due to the implicit nature of the task — the latter being a well-established means of demonstrating knowledge in these patients. Amnesic performance on the indirect tests could be seen as an example of implicit memory in that knowledge was implied *indirectly* in the patients' response confusions. Although patients could not remember studied occupations, their errors indicated they had knowledge of their higher-level category membership. For example, patients tended to confuse the occupations "teacher" and "lecturer" when presented with the face of an educator, but rarely responded with "plumber" or "electrician". However, our indirect tests differ from other demonstrations of implicit memory in amnesia as they required patients to remember studied occupations *explicitly* (In fact, given patients were consciously engaged in the task at the time of test, the present indirect tests are more like those used to demonstrate covert recognition in patients with prosopagnosia (e.g., de Haan, Young and Newcombe, 1987; Tranel & Damasio, 1985)). The "implicit" evidence of memory here is provided by the nature of errors in explicit recall. A catch-all appeal to an "implicit" memory is not a satisfactory explanation of this effect. As indicated earlier in a review of the amnesia literature (i.e., in Chapter 2), implicit memory phenomena are disparate. The present findings, together with those reviewed earlier, underline the point that every form of implicit memory requires its own explanation.

Irrespective of the type of test, amnesic patients showed better memory for general category membership than they did for lower-level category membership. The difficulty lies in explaining why they could access knowledge at the highest levels on direct tests (e.g., familiarity in the case of one patient in Experiment 4) and at intermediate levels on indirect tests (e.g., involving discrimination of educators from tradespeople in Experiment 1). In one sense the direct and indirect tests are similar — they both examined knowledge about occupations explicitly. However, the cues provided in the two types of test differed and these might tap different aspects of the stored information (cf. study-test mismatch, see Bransford, Franks, Morris & Stein, 1979). In the indirect tests the occupations presented at study and test were the same, but in the direct tests the recognition cues provided at test differed from those encountered at study. As a result of studying four specific occupations (e.g., teachers, lecturers, electricians and plumbers), higher-level category membership (i.e., educators, tradespeople) might be highlighted in an effort to distinguish the professions. By presenting the same four occupations at test (i.e., indirect tests) the associative pathway between specific and general occupations created at the time of encoding could be retraced, leading to a facilitation in memory performance. Such a mechanism cannot support performance on direct tests as no associative pathway can be formed with occupations that were not encountered at study.

Preservation of memory for generalities and the role of context

In Experiment 1 patients acquired sufficient knowledge to discriminate educators from tradespeople but not between subtypes of educator and subtypes of tradesperson. One interpretation of this result is that learning of novel associations is restricted to a particular level of knowledge — in this case, that involving educators and tradespeople. What determined the level of categorization which could and could not be acquired? The studied occupations in this experiment (i.e., teachers, lecturers, electricians and plumbers) are arguably "basic" Roschian categories (e.g., Rosch et al., 1976), and it is possible that new learning in amnesia is confined to the superordinate categories of educator and tradesperson.

It is also possible that the "higher" and "lower" level status of particular categories was defined by the study context — that is, by the specific stimulus sets used in the experiment. The presentation of teachers and lecturers in the context of plumbers and electricians, may have served to highlight a distinction between educators and tradespeople. Yet a different distinction would be required if differences between subtypes of teacher and subtypes of lecturer are to be remembered. According to this analysis, knowledge at any level in a taxonomic hierarchy can be high or low depending on the learning conditions.

These alternatives were investigated in Experiment 2 and results indicated that for at least one patient the ability to discriminate teachers from lecturers changed with a modification in study context. When the teacher/lecturer distinction represented the lower-level detail (i.e., in Experiment 1) both patients failed to differentiate people on this basis. However, when it represented the higher-level categorization (i.e., in the context of subtypes of teacher and subtypes of lecturer) one patient was capable of making the discrimination. For this patient knowledge of the association between people and the teacher/lecturer distinction was available in one study context and not another. This suggests that there is nothing special about any one level of knowledge.

The one theory from the amnesia literature which is central to this issue of context-sensitivity is the contextual memory deficit hypothesis. According to this theory, the memory deficit in amnesia arises from a failure to process the contextual aspects of information. However, our findings are inconsistent with this view. In Experiment 1 one patient (i.e., TG) did not discriminate between teachers and lecturers when these were embedded in a broad learning set. Yet in Experiment 2 there was evidence that she could discriminate at this level within a narrow learning set confined to educators and comprising subclasses of teacher and lecturer. It was suggested that the change in memory performance might be explained in terms of a shift in encoding strategy employed (cf. Baddeley's notion of intrinsic context discussed in Chapter 2). Contrary to the contextual memory deficit hypothesis, the mere fact that there was evidence of improvement indicates that the patient could process contextual information.

Context sensitivity is, however, compatible with a fragmentary knowledge type account. As alluded to earlier, we might suppose that one effect of shifting to a narrow learning set in the second experiment was that it induced the patient to encode the associations in terms of more specific semantic attributes than those used in Experiment 1 (i.e., attributes which would distinguish primary school teachers from secondary school teachers). In Experiment 2, as in Experiment 1, a fragmentary representation of this form would allow confusions between members of the most similar occupational categories (primary/secondary teachers) while preventing confusions between members of less similar occupations (primary school teachers/lecturers). In other words, the same mechanism could be operating in both experiments but on semantic representations at different levels of specificity.

Superior memory for generalities in the non-impaired

Experiments 1 to 8 provided evidence of preserved memory for generalities in amnesic patients. Experiment 9 indicated, using the same techniques, that the effect can also occur in a non-clinical population when it is subjected to suboptimal learning conditions. As noted earlier, this supports a range of evidence which suggests that under conditions of poor memory, normal individuals tend to remember general information better than specific details (e.g., Bransford & Franks, 1971; Yarmey, 1973).

Given that preserved memory for generalities occurs in non-clinical populations, it could be argued that it is simply a property of poor memory representation, irrespective of their cause. In this case, why is it of interest that the effect occurred in amnesic patients? It is of interest in that it shows that material which superficially appears lost, is available to the patients at an abstract level. This finding clearly bears on any explanation of amnesia and it carries implications for the assessment of amnesic memory. The effect in amnesic patients is also of interest for two other reasons. First, the type of test (i.e., direct and indirect) influenced the performance of amnesic patients but not controls. Second, amnesic patients showed a pattern of residual knowledge which was not found in the non-impaired group. In amnesia, impairment of specific knowledge was found in the context of preserved general-level knowledge. Although the non-impaired group remembered general information better than specific details, their performance at the two levels of categorization was intact. Thus, while the phenomenon can be described as *preserved* memory for generalities in amnesia, it is best classified as *superior* memory for generalities in the non-impaired.

A parsimonious assumption is that the superior acquired memory for generalities observed in the non-impaired group is supported by the same mechanisms as that seen in AA. On this basis, the presence of the effect in the non-impaired enables us to exclude one suggested explanation for the effect seen in clinical patients. The possibility that the generalities phenomenon is simply a product of testing procedure can be discounted as in the non-clinical group indirect measures were no more effective than direct ones in accessing knowledge. This finding suggests that the preservation of memory for generalities observed in amnesia is not simply a consequence of poor memory. It is likely that another feature of amnesic memory is responsible for producing the difference observed on direct and indirect tests, though it is not really clear from results of the present investigation what this feature may be.

Modality differences in access to information about people

One patient, TG, showed consistent evidence of differential access to person-related information via cues presented in different modalities. She accessed more information from a person's name than she did from their face. This was found in Experiment 6, which investigated autobiographical memory for generalities. It was confirmed in Experiment 8, which investigated remote knowledge in the public domain. This is particularly striking since the information requested at the point of memory failure with faces was identical to that with names and yet the details provided in response to the latter cue were accurate.

The differential performance with faces and names was unexpected. This modality-based differentiation, while not central to theories of amnesia, is relevant to theories of person recognition. In particular, differences in the amount of information accessible via faces and names challenge current theories which propose a unitary semantic information store. A current model of the different stages involved in face and name recognition is outlined below. Its capacity to explain TG's performance will then be considered.

A functional model of the stages involved in person recognition

There have been a several important developments in modelling the processes involved in recognizing and recalling information about people. Early models of person recognition focused primarily on the processes involved in recognizing people from their faces (Bruce & Young, 1986; Hay & Young, 1982). Subsequent models have addressed additional features of person recognition, and in particular, the involvement of names in the recognition process (Brédart, Valentine, Caldor & Gassi, 1995; Burton & Bruce, 1992, 1993; Burton, Bruce & Johnston, 1990; Valentine Brédart, Lawson & Ward, 1991). In general, there seems to be agreement over the main components involved in person recognition, though the internal organisation of these components remains a point of contention.

Several stages are believed to be involved in the process of recognizing a person and the main components are shown in the model illustrated in Figure 10.2. The first stage of processing involves the formation of a representation that contains a visual description of a seen face. This is compared with all known faces which are believed to be contained in the face recognition units. Name recognition units serve a similar function to face recognition units, but are stored separately. From the next stage, which involves accessing semantic information specific to individuals (i.e., identity-specific semantics/person identity nodes), both sets of recognition units access common knowledge. It was initially suggested that the recognition units were involved in perceiving a person as familiar (Hay & Young, 1982). However, this recognition process has since been attributed to the person identity nodes (Burton et al., 1990). This is because information from a variety of sources (e.g., faces, names, voices) can support familiarity judgements and placing this function in a set of units common to all modalities eliminates redundant processing. Name retrieval occurs subsequent to recognition via this biographical route.

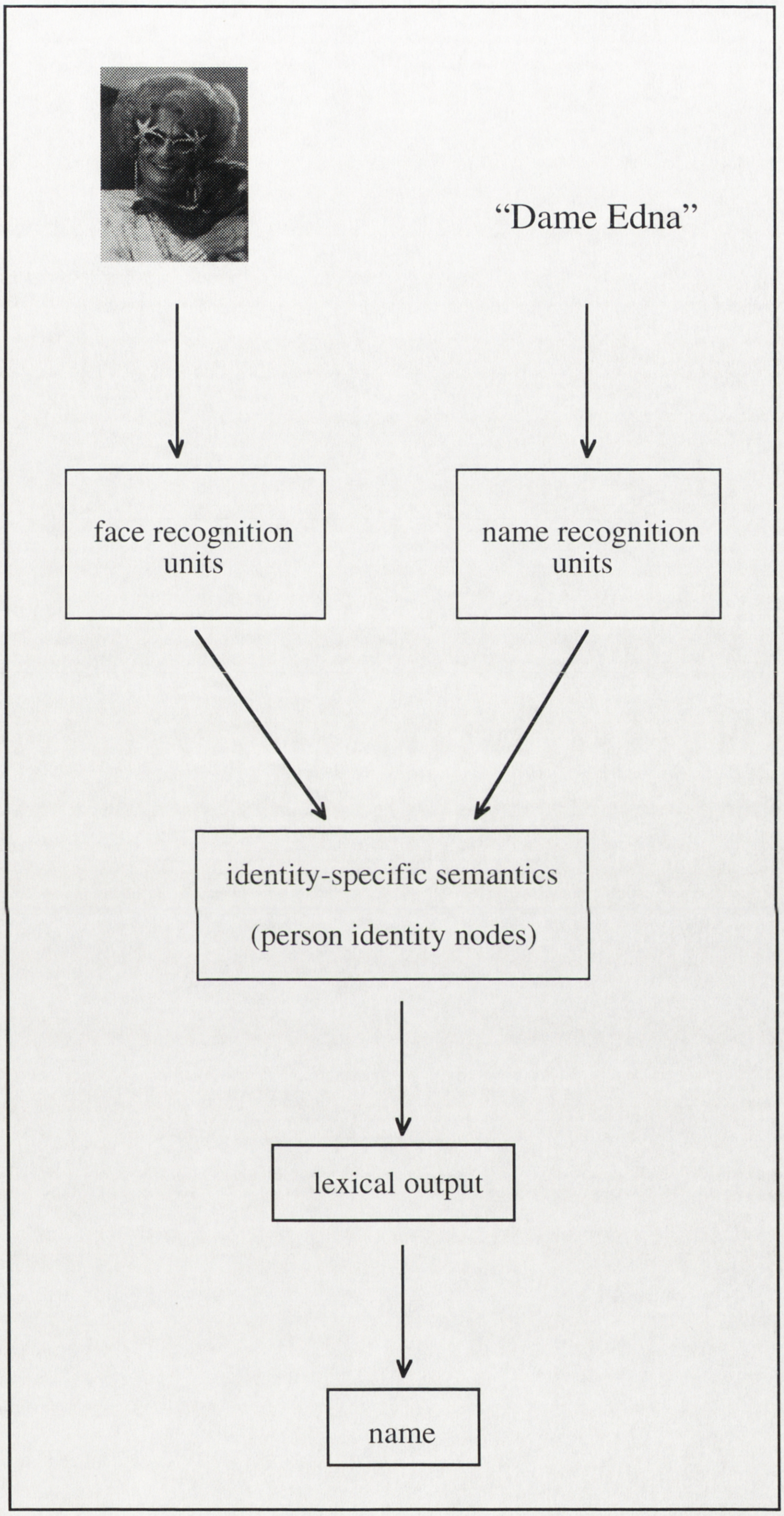

Figure 10.2 The central features of the functional model of person recognition adapted from Valentine et al. (1991) and illustrated in Green and Hodges (1996).

Explaining modality differences in access to knowledge

TG's results in two experiments (i.e., Experiments 6 and 8) can be considered in light of the current functional model of person recognition (refer to Figure 10.2). In Experiment 6, TG accessed sufficient autobiographical information from names to respond accurately to all the questions asked. Thus, her results with name cues suggested that the pathway from name recognition units to those containing semantic information was preserved. However, this was not the case with her responses to face cues where she failed to provide any accurate information beyond Level II. While performance at Level I only required a familiarity judgement, that at Level II required additional knowledge that would allow discrimination between famous people and those known personally to TG. In this case, both groups of people were familiar to the patient. TG indicated that she was familiar with the famous faces in her responses to questions at Level II, noting that while she would have liked them to be either family or friends, they were neither. To respond accurately at this level TG would have needed to access details from the semantic information units. If she could access some of this information in response to face cues, it is not clear why she could not access additional semantic details from this store. Moreover, as specific semantic details were accessible with names, it is difficult to explain why these details were not available with faces as well. In the model illustrated in Figure 10.2, this information is common to both modalities.

Similar difficulties are encountered in explaining TG's performance in Experiment 8, which examined knowledge in the public domain. In that experiment TG could only access sufficient information in response to faces to support fame judgements. Yet when presented with famous names, she accessed enough additional information to allow her to discriminate between people according to their basic occupational category (i.e., to discriminate actors from sportspeople). If familiarity is extracted from the person-identity nodes, then TG's deficit in the case of faces must occur after this point in the recognition process. However, as this route is common to both modalities, her ability to access additional semantic information in response to name cues cannot be explained.

Bruce and Young's (1986) original proposal, in which it was suggested that familiarity occurs at the recognition units (Bruce and Young, 1986), fares better in explaining TG's performance with famous people. If the face recognition units are involved in recognizing a person as familiar then TG's performance can be explained by damage to the connection between these units and the person identity nodes. Familiarity is supported by the face recognition units and additional information cannot be accessed from faces because these units have been disconnected from the rest of the system. The disconnection does not affect the name route and hence information can be accessed using this cue type.

The problem with the current model of face recognition is that it does not account for deficits in access to semantic information in one modality and not another. If semantic information is available in response to name cues then it is not clear why the same knowledge cannot be accessed in a different modality. It is possible that the knowledge contained in each unit is modality-specific. But, perhaps a more plausible explanation is that the association between faces and semantic attributes is weaker than that between names and semantic attributes. We know that TG retained knowledge about faces (because familiar faces were recognized) and, at the very least, higher-level semantic information (otherwise differential access to knowledge would not have been found). The problem lies in explaining why the association between attributes and faces is weaker than that with names — a point seemingly problematic for the current model and one that needs to be addressed in future research.

10.3 Final comment

The present investigation into preservation of memory for generalities began with the notion that the phenomenon might occur in clinical conditions other than dementia. Evidence to support this was found in both anterograde and retrograde amnesia. However, it was also found that memory for generalities was not restricted to clinical conditions. A non-clinical population remembered general information better than specific details when partial learning was induced. The preservation of memory for generalities phenomenon is therefore not confined to pathological conditions. It appears to occur in any situation where memory is imperfect.

The fact that existing theories of amnesia cannot account for preservation of memory for generalities is problematic and troubling. The aim of much of the greater body of research conducted with amnesics is to develop theories about normal memory function based on the pattern of preserved and impaired abilities observed in these patients. Because the generalities phenomenon occurs in amnesia and is fundamental to our understanding of memory, then it is reasonable to expect it to be addressed within theories of amnesia. This does not mean that there are no adequate theories of the phenomenon (as the fragmentary knowledge account attests), but it highlights the importance of integrating theories of memory from various sources.

More important though, is what we have learned about amnesia in the process of investigating the generalities phenomenon. It is clear from the present findings that amnesic patients can acquire novel memory traces and retain pre-existing knowledge, but this appears to be confined to fragments of the original information. While the actual content of memory traces is unclear, they are sufficient to support performance on tests of more general-level knowledge. As the fragmentary knowledge account suggests, there is no need to make assumptions about the actual content of these traces and indeed, it is most likely that they are highly individualized. Furthermore, the partial knowledge demonstrated in the present investigation does not appear to be confined to particular knowledge domains. It was demonstrated, for example, in the context of learning novel *semantic* associations and under *explicit* instruction. Thus, despite the emphasis in the amnesia literature on identification of intact and damaged knowledge domains, results of the present investigation suggest that knowledge in any domain might be accessible provided the information requested is sufficiently general. Finally, the facilitation in memory performance observed in amnesic patients under indirect testing conditions may be independent of the generalities phenomenon. The fact it was not evident in a non-clinical group suggests it may be a specific feature of amnesic memory and not other manifestations of poor memory.

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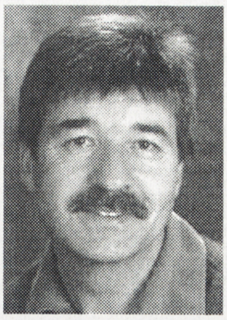
Appendices

Appendix 1: Appendices for Experiments reported in Chapter 6

(a) Examples of studied faces used in Experiment 1

Plumber



Plumber

Electrician

Electrician

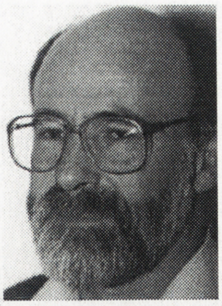
Teacher

Teacher

Lecturer

Lecturer

(b) Examples of studied faces used in Experiment 2

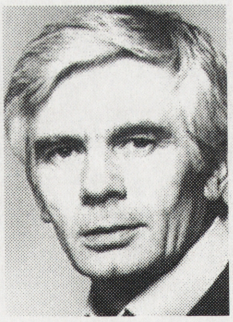


High School Teacher

High School Teacher

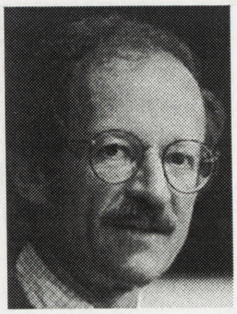
Primary School Teacher

Primary School Teacher



University Lecturer

University Lecturer



TAFE Lecturer

TAFE Lecturer

Appendix 2: Appendices for Experiments reported in Chapter 7

(a) Examples of studied faces used in Experiment 4

Mary Logan
Primary School Teacher

Alex Mattick
Primary School Teacher

Peter Ritchie
High School Teacher

Barbara Hutchings
High School Teacher

Patricia Innes
Violinist

Richard Lacey
Violinist

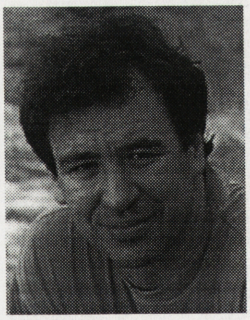
Stephen Carter
Pianist

Victoria Adams
Pianist

(b) Studied names, studied professions and modified names used in Experiment 4

Studied Name	Studied Profession	Modified Name (if used)
Mary Logan	primary school teacher	Mary Lomas
Wendy Ogden	primary school teacher	--
Elise Farrell	primary school teacher	Elise Farrow
Michael Kershaw	primary school teacher	Michael Kersten
Alex Mattick	primary school teacher	--
Michelle Luton	high school teacher	Michelle Lutter
Barbara Hutchings	high school teacher	--
Gary Harris	high school teacher	--
Jack Ellwood	high school teacher	Jack Elkins
Peter Ritchie	high school teacher	--
Patricia Innes	violinist	Patricia Inglis
Kathy Driscoll	violinist	--
Cindy Edwards	violinist	Cindy Edmund
Richard Lacey	violinist	Richard Lalor
Phillip Gardner	violinist	--
Jacqui Palmer	pianist	--
Victoria Adams	pianist	Victoria Adler
Stephen Carter	pianist	Stephen Carson
George Norris	pianist	--
Matthew Bradfield	pianist	--

(c) Examples of non-studied faces used in Experiment 4



(d) Non-studied names used in Experiment 5

Donna Roland	Brett Sanders
Belinda Hyland	Jeremy Cowan
Gail Jory	Greg Molina
Miranda Prosser	Tod Hansell
Melinda Urquhart	Harry Coleman
Kylie Walton	Craig Lucas
Jean Tanner	Wayne Leighton
Anna Nesbitt	Darren Horder
Janice Foley	Frank Arden
Elinor Felton	Eric Bradley

Appendix 3: Appendices for Experiments reported in Chapter 8

(a) Famous people used in Experiment 6

Flo Bjelke-Peterson

Jean Kitson

Queen Elizabeth

Barbara Stanwyck

Alicia Silverstone

Tony Pearen

Kylie Minogue

Susan Olsen

Anna Paquin

Denise Roberts

Rowena Wallace

Andrew Lloyd-Webber

Rob de Castella

Grant Kenny

Gene Hackman

Clint Eastwood

James Richter

Derryn Hinch

Lloyd Bridges

Macauley Culkin

(b) Examples of famous faces used in Experiment 6

Queen Elizabeth II

Barbara Stanwyck

Denise Roberts

Kylie Minogue

Grant Kenny

Andrew
Lloyd-Webber

Clint Eastwood

Lloyd Bridges

(c) Novel names used in Experiment 6

Leonie Evans

Melanie Dell

Leslie Barker

Mary Barker

Elsie Newman

Kylie Fraser

Elizabeth Cantrill

Jenny Napier

Kerry Sweeney

Warren Sweeney

Julie Slater

Susan Turnbull

Laurie Smith

Greg Morris

Jim Doherty

Warren Patterson

Kevin Prescott

Paul Bennet

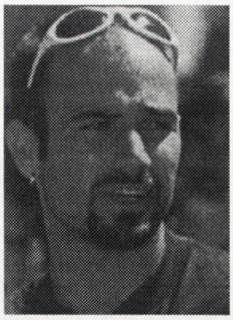
Patrick Kane

Jason Stapleton

(d) Famous people used in Experiment 8

Actors	Sportspeople
Kim Basinger	Andre Agassi
Jodie Foster	Kieren Perkins
Nicole Kidman	Pete Sampras
Michelle Pfeiffer	Laurie Daley
Meg Ryan	Greg Norman
Bruce Willis	Kathy Freeman
Mel Gibson	Steffi Graf
Tom Hanks	Conchita Martinez
Hugh Grant	Melinda Gainsford
Kevin Costner	Monica Seles

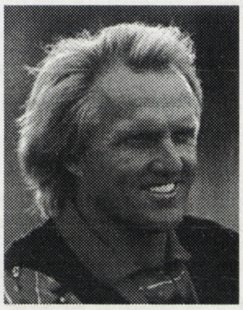
(e) Examples of famous faces used in Experiment 8



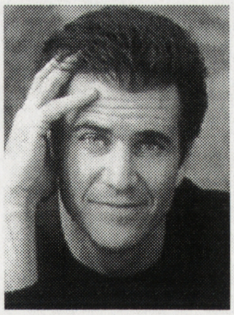
Andre Agassi

Steffi Graf

Monica Seles



Greg Norman



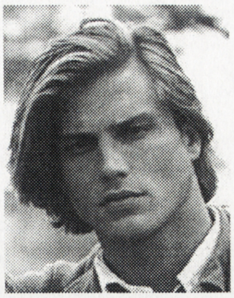
Mel Gibson

Jodie Foster

Nicole Kidman

Kevin Costner

(f) Examples of non-famous faces used in Experiment 8



(g) Novel (non-famous) names used in Experiment 8

Henry Nagle

Patrick Thornton

Russell Brown

Adam Gilbert

Ian Draper

Ken Joyce

Edward Kirk

David Hall

Frank Newton

Malcolm Sands

Helen Palmer

Sara Bilski

Kerrie Walsh

Rachael Fallon

Carol Reed

Fiona Cowley

Leeanne Ashford

Amanda Lawton

Elizabeth Evans

Dianne Mackie

(h) Correct and modified names of famous people used in Experiment 8

Correct name	Modified name (if used)
Kim Basinger	Kim Basinford
Jodie Foster	--
Nicole Kidman	--
Michelle Pfeiffer	--
Meg Ryan	Meg Ryder
Kathy Freeman	--
Steffi Graf	Steffi Grant
Conchita Martinez	--
Melinda Gainsford	Melinda Gainey
Monica Seles	--
Bruce Willis	Bruce Williams
Mel Gibson	Mel Gibbons
Tom Hanks	--
Hugh Grant	--
Kevin Costner	Kevin Costin
Andre Agassi	--
Kieren Perkins	Kieren Perley
Pete Sampras	Pete Sampson
Laurie Daley	--
Greg Norman	Greg Norden